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Instruction Manual

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INSTRUMENTS / COMPONENTS

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June 15, 1966

MODEL 873A, 873AB
AC/DC DIFFERENTIAL VOLTMETER

873A & 873AB serial no._____and above.

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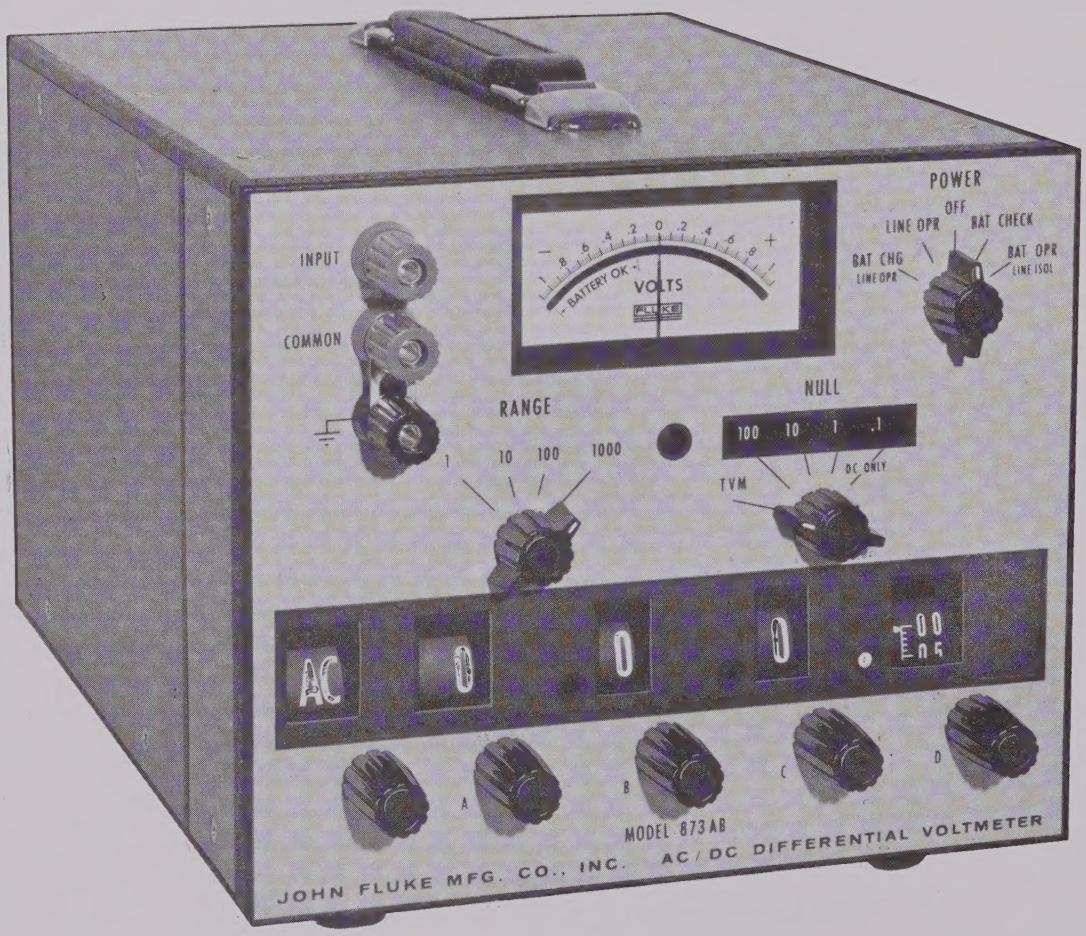


MODEL 873AB AC/DC DIFFERENTIAL VOLTMETER

SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. This instruction manual is for use with the 873A series AC/DC Differential Voltmeters. This instrument is available as either line-powered (Model 873A), or as a combination line-powered/battery-powered instrument (Model 873AB). Both instruments are half rack size and are equipped with rubber feet and tilt-up bail for field or bench use. A single instrument may be mounted in a standard 19 inch rack by means of metal handle rack adapter kit 881A-102. Two instruments may be mounted side-by-side by means of metal handle rack adapter kit 881A-103.

1-3. The 873A series instruments are capable of being used as: (a) Conventional voltmeters for rapid determination of ac and dc voltages from 0 to 1100 volts to within 3% of range setting. (b) Differential voltmeters for precise measurement of ac and dc voltages from 0 to 1100 volts, and (c) Megohmmeters for measurement of resistance from 10 megohms to 100,000 megohms with a typical accuracy of 5%. The instrument can also be used to measure the excursion of an ac or dc voltage about a nominal value. In measuring dc voltages equal to or less than 11 volts, no current is drawn from the unknown voltage source at null. Thus, the determination of the unknown potential is independent of its source resistance. Above 11 volts, the dc input resistance is 10 megohms. AC input impedance is 1 megohm in parallel with 40 pf. To minimize errors due to common mode voltages, the 873A series is provided with extremely high dc leakage resistance to ground, typically several hundred thousand megohms. Where ground loop current may be present, complete isolation from the power line through battery operation of the 873AB eliminates this source of error. The 873A series contains a polarity switch for equal convenience in measuring positive or negative dc voltages, or ac voltages. An adjustable recorder output is also provided for monitoring the meter deflection. Shock, vibration, humidity, and temperature testing assure years of hard use under severe environmental conditions.

1-4. When used as a differential voltmeter, the 873A and 873AB operate on the potentiometric principle. An unknown voltage is measured by comparing it to a known adjustable dc voltage with the aid of a null detector and, for ac measurements, an ac to dc converter. An accurate standard for measurement is obtained from an 11 volt reference supply derived from a pair of temperature-compensated zener diodes. The known adjustable reference voltage is provided by a Kelvin-Varley voltage divider with three decades of Fluke precision wirewound resistors and an interpolating vernier potentiometer, which are set accurately by four voltage readout dials to provide a five digit readout. In this way, the 11 volts can be precisely divided into increments of 10 ppm of range. At null, the unknown voltage is indicated by the voltage dials. For dc voltages between 11 and 110 volts, an input attenuator divides the unknown voltage by 10 before it is measured potentiometrically; for dc voltages between 100 and 1100 volts, the input attenuator divides the unknown voltage by 100.

1-5. INPUT POWER

1-6. The voltmeter is usually supplied with the primary windings of the power transformer connected in parallel for operation from 115 volts ac. Upon request, the instrument is supplied with the primary windings connected in series for operation from 230 volts. If it becomes desirable to convert from one operating voltage to the other, refer to the schematic diagram and the decal on the power transformer.

1-7. RECEIVING INSPECTION

1-8. This instrument has been thoroughly tested and inspected before being shipped from the factory. Immediately after receiving the instrument, carefully inspect for damage which may have occurred in shipment. If any damage is noted, follow the instructions outlined in the warranty page at the back of this manual.

1-9. SPECIFICATIONS

AS A DIFFERENTIAL VOLTMETER

DC ACCURACY: ±(0.02% of input voltage + 0.001% of range) from 0 to 1100 vdc.

AC ACCURACY:

20 Hz to 10 kHz
±(0.2% of input + 25 uv) from 0.001 to 1100 v.
10 kHz to 20 kHz
±0.3% of input from 0.1 to 1100 v.
10 Hz to 20 Hz
±(0.3% of input + 25 uv) from 0.001 to 1100 v.
20 kHz to 50 kHz
±1% of input from 0.1 to 110 v.
5 Hz to 10 Hz
±(1% of input + 25 uv) from 0.001 to 1100 v.
50 kHz to 100 kHz
±2% of input from 0.1 to 110 v.

INPUT RANGES: 1, 10, 100, and 1000 volts, ac and dc, with 10% over-ranging.

NULL RANGES:

Input Voltage Range	Null Ranges	Input Resistance at Null	
		dc	ac
1 v	.1, .01, .001 v	Infinite	1 megohm, 40 pf
10 v	1, .1, .01, .001 v	Infinite	1 megohm, 40 pf
100 v	10, 1, .1, .01 v	10 megohms	1 megohm, 40 pf
1000 v	100, 10, 1, .1 v	10 megohms	1 megohm, 40 pf

VOLTAGE DIAL RESOLUTION:

Voltage Range	Resolution	
	ppm of range	volts
1 v	10 ppm	10 uv
10 v	10 ppm	100 uv
100 v	10 ppm	1 mv
1000 v	10 ppm	10 mv

METER RESOLUTION:

Meter Resolution (1/2 of a small scale division)	
Null Range	Resolution
.001	10 uv
.01	100 uv
.1	1 mv
1	10 mv
10	100 mv
100	1 v

AS A CONVENTIONAL VOLTMETER

DC ACCURACY: ±3% of range.

AC ACCURACY: ±3% of range within frequency and voltage ranges listed under ac accuracy as a differential voltmeter.

RANGE AND INPUT IMPEDANCE:

Voltage Range	Input Impedance	
	dc	ac
1000-0-1000	10 megohms	1 megohm, 40 pf
100-0-100	10 megohms	1 megohm, 40 pf
10-0-10	10 megohms	1 megohm, 40 pf
1-0-1	10 megohms	1 megohm, 40 pf
*.1-0-.1	10 megohms	1 megohm, 40 pf
*.01-0-.01	10 megohms	1 megohm, 40 pf
*.001-0-.001	1 megohm	1 megohm, 40 pf

NOTE: 10% over-ranging on each range.
*These ranges obtained by using null ranges with all readout dials set to zero.

GENERAL

POLARITY: Front panel switch selects +dc, -dc, or ac.

ELECTRICAL DESIGN: Completely solid-state.

INPUT RESISTANCE OF NULL DETECTOR: 10 megohms on two highest null ranges for all input ranges; 1 megohm on two lowest null ranges for all input ranges.

REFERENCE ELEMENT: Temperature-compensated zener diode, stability within ±50 ppm per year, and temperature coefficient less than 5 ppm/° C.

REGULATION OF REFERENCE SUPPLY: ±0.001% for a ±10% line voltage change.

STABILITY OF REFERENCE SUPPLY: ±0.002% per hour after a 5-minute warmup.

ACCURACY OF OFF-NULL DEFLECTION: ±5% of null range (±3% with voltage dials at zero).

KELVIN-VARLEY ACCURACY: ±0.01% of output from 1/11 of full scale to full scale. Ratio stability of decade resistors, ±25 ppm/year.

RECORDER OUTPUT: Adjustable from 0 to at least +20 mv for full scale right deflection, and from 0 to at least -20 mv for full scale left deflection.

WARMUP TIME: dc - 15 seconds; ac - 1 minute.

RELATIVE HUMIDITY: 0 to 80%.

COMMON MODE REJECTION: 130 db at dc; 85 db at 60 Hz; 70 db at 400 Hz.

NOTE: Battery operation of the 873AB provides complete isolation from power system ground, which eliminates errors due to ground loops.

OPERATING TEMPERATURE RANGE: Within dc accuracy specifications from 50° F to 104° F (10° C to 40° C); Within ±(0.05% of input voltage + 10 uv) dc accuracy outside these limits to 32° F and 122° F (0° C and 50° C).

Within ac accuracy specifications from 55° F to 95° F (13° C to 35° C), derated at ±0.005%/° F outside these limits to 32° F and 122° F (0° C and 50° C).

STORAGE TEMPERATURE RANGE: Model 873A, -40° F to +158° F (-40° C to +70° C). Model 873AB, -40° F to +140° F (-40° C to +60° C).

SHOCK AND VIBRATION: Meets requirements of MIL-T-945A and MIL-S-901B.

INPUT POWER: Model 873A - 115/230 vac ±10%, 50-440 Hz; Model 873AB - 115/230 vac ±10%, 50 - 440 Hz and rechargeable battery operation (minimum 30 hours operation on full charge).

SIZE: 7" high x 8-1/2" wide x 11-3/4" deep.

WEIGHT: Model 873A - approximately 12 lbs.
Model 873AB - approximately 14 lbs.

SECTION II

OPERATING INSTRUCTIONS

2-1. FUNCTION OF CONTROLS, TERMINALS AND INDICATORS

2-2. The location, reference designation, and a functional description of the external controls, terminals, and indicators on the 873A/873AB AC/DC Differential Voltmeter is given in Figures 2-1 and 2-2.

2-3. PRELIMINARY OPERATION–MODEL 873A

2-4. The following procedure prepares the Model 873A for operation.

a. Mechanically zero the meter with the adjustment screw on the front panel. If the instrument has been operating, it must be shut off for at least three minutes, with the meter terminals shorted, prior to this adjustment.

b. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

WARNING!

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead to a high-quality ground.

c. Set switches on 873A as follows:

RANGE	1000
NULL	TVM
polarity	+ (positive)
all voltage readout dials	zero
POWER	ON

2-5. PRELIMINARY OPERATION– MODEL 873AB

2-6. The following procedure prepares the Model 873AB for operation.

a. Mechanically zero the meter with the adjustment screw on the front panel. If the instrument has been operating, it must be shut off for at least three minutes, with the meter terminals shorted, prior to this adjustment.

b. For line operation, connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

WARNING!

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead to a high-quality ground.

c. For line operation, set the POWER switch to LINE OPR.

d. For battery operation, set the POWER switch to BAT CHECK. Meter needle should deflect to BATTERY OK region. If meter needle does not stay within BATTERY OK region for 10 seconds, charge batteries as outlined in paragraph 2-9. If batteries are adequately charged, set POWER switch to BAT OPR-LINE ISOL.

e. Set switches on 873AB as follows:

RANGE	1000
NULL	TVM
polarity	+ (positive)
all voltage readout dials	zero

2-7. ZEROING INSTRUCTIONS

2-8. If the meter needle indicates off zero at rest, it can be due to either incorrect mechanical zero or incorrect electrical zero. The meter can be zeroed as follows:

a. Short across the internal meter terminals, and adjust the mechanical zero control for meter null.

b. Short INPUT post to COMMON post.

c. Set switches on voltmeter as follows:

RANGE	1
NULL	.001
polarity	+ (positive)
all voltage readout dials	zero

d. Set POWER switch to ON with 873A, or to LINE OPR with 873AB, and allow the instrument to warmup for 1 minute.

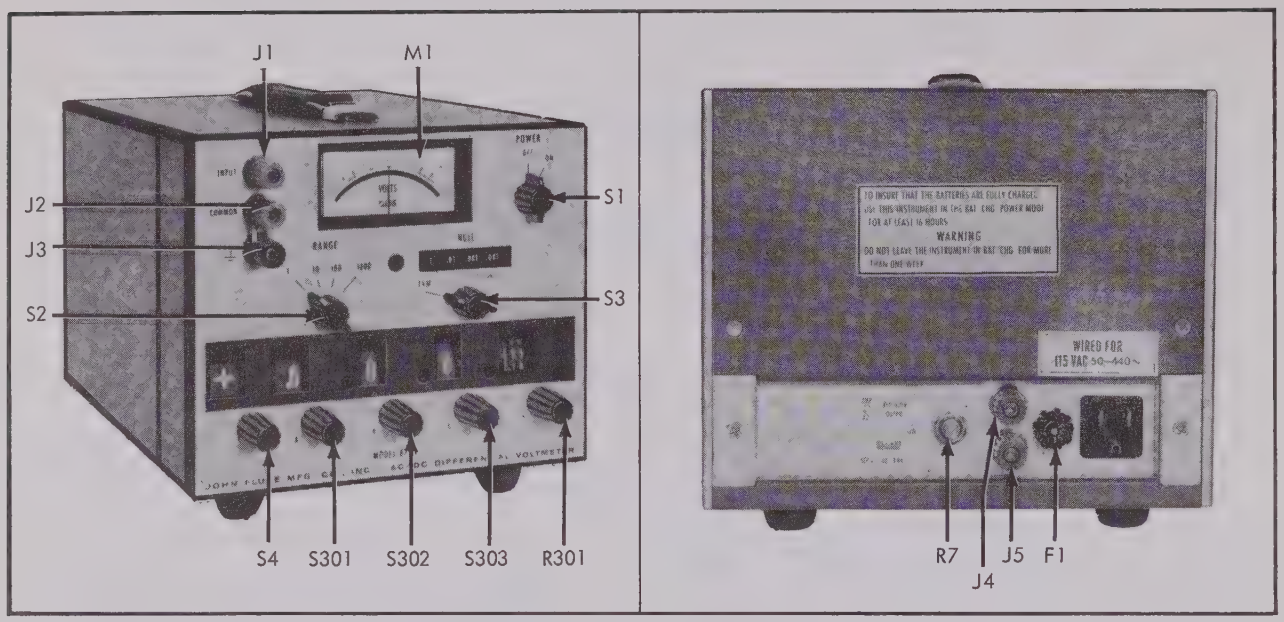


Figure 2-1. LOCATION OF CONTROLS, TERMINALS, AND INDICATORS

CONTROLS TERMINALS AND INDICATORS	REFERENCE DESIGNATION	FUNCTIONAL DESCRIPTION
INPUT and COMMON terminals	J1, J2	Provided for connecting voltage to be measured.
Chassis ground terminal	J3	Provided for grounding purposes. A 0.01 uf capacitor is connected from the COMMON binding post to the chassis ground post. To prevent possible incorrect measurements, the INPUT post should never be connected to the chassis ground post. Since the instrument is equipped with a three-wire line cord with the third wire fastened to the chassis, the circuit should be checked for conflicts in grounding before connecting the COMMON binding post to the chassis post.
POWER switch	S1	In the Model 873A, the POWER switch applies ac line voltage to primary circuit of transformer T1 when turned from OFF to ON. In the Model 873AB, positions for BAT CHECK, and three modes of operation (LINE OPR, BAT CHG - LINE OPR, and BAT OPR - LINE ISOL) are available. When set to LINE OPR, ac line voltage is applied to primary circuit of transformer. When set to BAT CHG - LINE OPR, ac line voltage is applied to primary of transformer and batteries are charged at the same time. When set to BAT OPR - LINE ISOL, battery power is applied to the instrument and both sides of primary circuit are open. When set to BAT CHECK, battery power is applied to the instrument, both sides of primary circuit are open, and meter is connected in series with a resistor to measure voltage drop across the series regulating transistor, Q101, which indicates the condition of the batteries.
RANGE switch	S2	Selects desired voltage range, changes null ranges appearing in NULL window, and positions decimal point for voltage readout dials. Voltage ranges of 1, 10, 100, and 1000 volts are available. A voltage 10% higher than range setting may be measured in each range.

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

CONTROLS TERMINALS AND INDICATORS	REFERENCE DESIGNATION	FUNCTIONAL DESCRIPTION
NULL switch	S3	Set to TVM for determining the approximate value of unknown voltage prior to differential measurements. Six null voltage ranges of 100, 10, 1, 0.1, 0.01, and 0.001 volts are used for differential measurements. These ranges represent full scale differences between the unknown voltage and the amount of precision internal reference voltage that is set on the voltage readout dials.
A, B, C, and D voltage readout dials	S301, S302, S303, R301	Provide in-line readout of the internal reference voltage.
Polarity switch	S4	Connects ac to dc converter for measurement of ac voltage, and changes polarity of voltmeter to match polarity of unknown for measurement of dc voltage. With this switch in the positive position, the polarity of INPUT binding post is positive with respect to COMMON binding post.
Mechanical zero control	None	Sets meter to zero mechanically. This adjustment should be used only after instrument has been turned off for at least three minutes and when the internal meter terminals have been shorted.
Meter	M1	Indicates approximate voltage when voltmeter is in TVM mode and difference between unknown and internal reference voltage when voltmeter is in differential mode.
RECORDER OUTPUT terminals	J4, J5	Provided for attaching a recorder to monitor voltage excursions.
AMP ADJ control	R7	Varies the output level of the recorder output binding post from 0 to at least 20 millivolts at full scale deflection.
Fuse	F1	Fuse holder protrudes from instrument to provide easy access to the fuse. The fuse is a 1/16 ampere slow blowing type for 115 volt operation and a 1/32 ampere slow blowing type for 230 volt operation of 873A. Fuse is a 1/8 ampere slow blowing type for 873AB.

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)

e. Remove the short from the internal meter terminals. Meter offset should be less than 1/4 small scale division in both dc polarities: if not, adjust R227 as necessary to zero the meter.

f. Remove the short between the INPUT and COMMON posts. Meter offset should remain within 1/3 small scale division in both dc polarities.

2-9. BATTERY CHARGING

a. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

b. Set POWER switch to BAT CHG-LINE OPR. After 16 hours, batteries will be fully charged and capable of operating the instrument for at least 30 hours. The instrument may be operated while the batteries are being charged.

CAUTION!

Since overcharging decreases battery life, it is recommended that the batteries be charged for less than 48 hours, and never more than 1 week. When used properly, the batteries will give more than 200 charge-discharge cycles.

2-10. OPERATION AS A DC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Connect unknown voltage between INPUT and COMMON post. If one side is grounded, always connect it to the COMMON post.

c. Turn RANGE switch to lowest range that will permit on-scale meter deflection, and note approximate value of unknown voltage.

d. If meter deflects to the left, the polarity of the unknown voltage is negative. Turn polarity switch to

the negative position. The meter will deflect to the right.

e. Noting position of decimal point, set four voltage readout dials to the approximate voltage determined in step c. For example, if the approximate voltage was 35 volts, decimal point will be between the B and C readout dials. Therefore, set dial A to 3 and dial B to 5.

f. Set the NULL switch from TVM to the first null position for the range being used, and adjust the readout dials for zero meter deflection.

g. Adjust the readout dials for zero meter deflection in successively more sensitive null ranges. When the meter needle deflects to the right, the magnitude of the voltage under measurement is greater than the voltage set on the readout dials. When deflection is to the left, the voltage under measurement is less than the voltage set on the readout dials.

h. When the meter is at null on the most sensitive null range, the unknown voltage equals the value set on the four readout dials.

2-11. OPERATION AS AN AC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Set polarity switch to AC.

c. Connect unknown ac voltage between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.

d. Set RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.

e. Noting the position of the decimal point, set four voltage readout dials to approximate voltage determined in step d. For example, if the voltage is approximately 35 volts, the decimal point will already be between the B and C voltage readout dials. Therefore, set dial A to 3 and set dial B to 5.

f. Set NULL switch to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to the right, magnitude of voltage being measured is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on the readout dials.

g. Read unknown voltage directly from the four voltage readout dials.

2-12. OPERATION AS A CONVENTIONAL VOLTMETER

2-13. If it is desired to use the instrument as a conventional 3% voltmeter only, additional ranges can be made available by converting the NULL ranges to conventional voltmeter ranges. This is made possible by setting the voltage readout dials to zero, and setting the range switch to 1 volt. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Refer to Figure 2-3, and select full scale voltage deflection desired. If approximate value of voltage to be measured is unknown, select the 1000 volt range initially.

c. Set RANGE switch, NULL switch, and voltage dials as indicated in Figure 2-3 for the range selected.

d. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post. Deflection to the right indicates that the unknown dc voltage is of positive polarity. An unknown ac voltage will always cause deflection to the right.

FULL-SCALE DEFLECTION (VOLTS)	POLARITY SWITCH POSITION	RANGE SWITCH POSITION	NULL SWITCH POSITION	VOLTAGE READOUT DIAL POSITIONS
DC:				
1000-0-1000	+	1000	TVM	No effect
100-0-100	+	100	TVM	No effect
10-0-10	+	10	TVM	No effect
1-0-1	+	1	TVM	No effect
.1-0-.1	+	1	.1	All zero
.01-0-.01	+	1	.01	All zero
.001-0-.001	+	1	.001	All zero
AC:				
0-1000	AC	1000	TVM	No effect
0-100	AC	100	TVM	No effect
0-10	AC	10	TVM	No effect
0-1	AC	1	TVM	No effect
0-.1	AC	1	.1	All zero
0-.01	AC	1	.01	All zero
0-.001	AC	1	.001	All zero

Figure 2-3. TVM RANGES

2-14. MEASUREMENT OF VOLTAGE EXCURSIONS ABOUT A NOMINAL VALUE

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
b. Set polarity switch to desired position.
c. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post. Deflection to the left indicates that the voltage being measured is negative; set polarity switch to the negative position. This will cause meter pointer to deflect to the right.
d. Measure nominal value of voltage to be observed by setting RANGE switch to lowest range possible without driving meter deflection off-scale.
e. Set four voltage readout dials to nominal value measured in step d.
f. Set NULL switch to maximum sensitivity possible without driving voltage excursions off-scale.
g. Voltage excursions are indicated by meter. Note that full scale right and left meter deflections are equal to the NULL range setting (disregarding 10% overranging). Meter deflection to the right indicates that the magnitude of voltage under observation has increased above the nominal value; deflection to the left indicates voltage has decreased below nominal value.

2-15. RECORDING VOLTAGE EXCURSIONS

2-16. Recorder output binding posts and an output level control are provided on the 873A and 873AB for monitoring the excursions of an unknown voltage from the voltage indicated by the voltage readout dial settings. If the leakage resistance between the recorder and ground is less than 10,000 megohms, the accuracy of the voltmeter will be impaired. Therefore, the FLUKE Model A88 Isolation Amplifier is recommended for this application. The A88 will allow the use of a wide range of inexpensive recorders for recording voltmeter deflection, without regard to the input isolation characteristics of the recorder.

2-17. USE OF 873A WITH AN A88 ISOLATION AMPLIFIER AND A RECORDER

2-18. To use the Fluke A88 Isolation Amplifier and a recorder with the 873A or 873AB, proceed as follows:

a. Set A88 POWER switch to ON.
b. When batteries are being used as a power source for A88, measure voltage at BATT TEST jacks. If voltage is between 11.7 and 14 volts DC, the batteries are satisfactory for use. However, if battery voltage is below 12.5 volts, batteries are approaching end of their useful life and should be replaced.
c. Connect RECORDER OUTPUT terminals of differential voltmeter to INPUT terminals of isolation amplifier with teflon leads.
d. Connect OUTPUT terminals of isolation amplifier to recorder input terminals.
e. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
f. Short INPUT post to COMMON post and set switches on voltmeter as follows:

RANGE	10
NULL	1
voltage readout dials	1.00 00

The meter will indicate full scale (-1.0).
g. Turn on the recorder and set recorder gain for a full scale sensitivity equal to or less than 2 volts, but as close to 2 volts as possible.
h. Adjust AMP ADJ control on rear of differential voltmeter until recorder deflection obtained is that desired to correspond to full scale deflection of the differential voltmeter.
i. Remove short from INPUT to COMMON post. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed according to paragraph 2-14.

2-19. USE WITH A RECORDER

2-20. To use a recorder with the 873A or 873AB, proceed as follows:

a. Using teflon insulated leads, connect RECORDER OUTPUT terminals of differential voltmeter to input terminals of recorder.

Note!

Do not ground either of the voltmeter RECORDER OUTPUT terminals or either of the recorder input terminals. If any of these terminals are grounded, current will be drawn from the Kelvin-Varley divider and the voltmeter will no longer be accurate.

b. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
c. Check for excessive electrical leakage as follows:

(1) Set switches on voltmeter as follows:

RANGE	10
NULL	.001
polarity	+ (positive)
voltage readout dials	10.0000

(2) Connect either recorder lead to the INPUT binding post, and connect the common side of the voltage to be measured to the COMMON binding post. A deflection of more than full scale (-1.0) indicates excessive leakage.
d. Short INPUT post to COMMON post and set switches on voltmeter as follows:

RANGE	10
NULL	1
voltage readout dials	1.00 00

The meter will indicate full scale (-1.0). This provides a maximum of at least 20 millivolts at the RECORDER OUTPUT terminals depending on the setting of the AMP ADJ control. Reconnect recorder to RECORDER OUTPUT terminals.
e. Adjust AMP ADJ control until recorder deflection obtained is that desired to correspond to full scale deflection of the voltmeter.

f. Remove short between INPUT and COMMON posts, and connect voltage to be measured to INPUT and COMMON posts. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed according to paragraph 2-14.

2-21. MEASUREMENT OF HIGH RESISTANCE

2-22. The 873A series voltmeter may be used as a megohmmeter for rapid measurements of high resistances from 10 megohms to 100,000 megohms with a typical accuracy of 5%. The following equation may be used to compute the resistance in megohms of an unknown connected to the input binding posts when the RANGE switch is set to 10.

$$R_x = R_i \left(\frac{E}{E_m} - 1\right) \text{ megohms}$$

Where:

R_x is the unknown resistance in megohms.

E is the voltage indicated by the voltage readout dials.

E_m is the voltage indicated on the meter.

R_i is the input resistance of the TVM circuit in megohms and is 10 for the 1 and 0.1 null range and 1 for the 0.01 and 0.001 null range on the 10 volt range.

2-23. A convenient way of measuring leakage resistance between 10 megohms and 11,000 megohms is to adjust the voltage readout dials so that the meter indicates full scale (-1.0). The unknown resistance is then easily calculated from the readout dial setting. Proceed as follows:

a. Perform preliminary operation, paragraph 2-3 or 2-5.
b. Set RANGE switch to 10.
c. Set NULL switch to 1.
d. Connect unknown resistance between INPUT post and COMMON post. Use short insulated leads to prevent measuring the leakage resistance between the leads.
e. Adjust voltage readout dials for full scale meter deflection (-1.0). If full scale deflection cannot be obtained with NULL switch set to 1, set NULL switch to 0.1 or 0.001.
f. Determine value of unknown resistance according to Figure 2-4.

2-24. NOTES ON OPERATION OF 873A AND AB

2-25. GROUND LOOP PRECAUTIONS

2-26. Ground loop currents should be avoided to assure measurement accuracy. A potential difference often exists between different points on power system grounds. When this occurs, current may flow from the power system ground through the voltmeter and the equipment being measured and back to the power system ground. To prevent ground loop currents when the system being measured is grounded, do not connect COMMON post to chassis ground post.

2-27. USE OF SHORTING LINK

2-28. An 0.01 uf capacitor (C1) is connected from the COMMON binding post to the chassis ground binding post, which reduces the effect of circulating ac currents from the transformer. In some cases, it is possible for C1 to acquire a charge. For example, C1 will become charged when making measurements in the presence of common mode voltages. This charge may cause an error on subsequent low level measurements (under 5 volts), due to C1 discharging through the Kelvin-Varley divider and leakage resistance to ground. Connecting the shorting link from the COMMON post to the ground post for a few seconds will discharge C1 and thus prevent an incorrect indication.

2-29. CHECKING BATTERIES OF 873AB

2-30. If the 873AB is turned off with the batteries completely discharged, the battery voltage may recover with time. It is possible for the batteries to recover sufficiently for the meter to indicate that they are charged, when the power switch is first set to battery check. However, after a few seconds, the battery voltage will fall, and the meter will indicate that the batteries need to be charged. It should be noted that the discharge characteristic of nickel-cadmium batteries is nearly flat, except near full charge and complete discharge. Therefore, when the batteries are checked, the meter indication is not proportional to the remaining ampere-hour capacity of the batteries. Just after the batteries are charged, the meter will indicate near full scale. However, most of the time the meter will indicate near half scale. A few hours before the batteries need recharging, the meter needle will indicate just within the BATTERY OK region.

RANGE OF UNKNOWN RESISTANCE	NULL SWITCH POSITION	UNKNOWN RESISTANCE IN MEGOHMS AT FULL-SCALE (-1.0) METER DEFLECTION
10 megohms to 100 megohms	1	Multiply amount set on voltage readout dials by 10 and subtract 10.
90 megohms to 1090 megohms	0.1	Multiply amount set on voltage readout dials by 100 and subtract 10.
1000 megohms to 11,000 megohms	0.001	Multiply amount set on voltage readout dials by 1000.

Figure 2-4. RESISTANCE MEASUREMENTS AT FULL SCALE DEFLECTION

2-31. NOTES ON MEASURING DC VOLTAGES

2-32. AFFECT OF AC COMPONENTS ON DC MEASUREMENTS

2-33. An ac voltage of several times the unknown dc voltage can be present on the unknown and the 873A or 873AB will indicate well within the specifications, if the frequency is over a few hundred cycles. A double-section, low-pass filter (R201, C201, R202, and C202) at the input of the null detector reduces any ac present on the dc being measured. At lower frequencies, this low-pass filter is less effective, and the magnitude of the ac component may be significant. If the low frequency ac component is equal to or less than 1000 times the null range being used, no perceptable error will result. For example, on the .01 volt null range, a 60 Hz ac voltage of up to 10 volts will cause no perceptable error. When the frequency is very close to a multiple or submultiple of the chopper frequency (approximately 84 Hz), the meter needle will oscillate at the difference frequency. If ac components that affect the accuracy are ever encountered, additional filtering at the input of the instrument will be necessary. For alternating current of a single frequency, a twin-T filter is effective, and has low total series resistance. For an alternating current of various frequencies, an ordinary low pass filter may be used. In either case, the filter should be constructed of high quality capacitors which have high leakage resistance.

2-34. EFFECT OF DC COMMON MODE VOLTAGE

2-35. Care has been taken in the design and construction of the 873A to isolate the circuitry from chassis ground. Accurate dc measurements can be made with the 873A and 873AB in the presence of common mode voltages of up to 1000 volts dc. The dc common mode rejection is at least 130 db (3,160,000 to 1), or 0.35 uv error per common-mode-volt, up to 70% relative humidity. Since the leakage resistance varies inversely with dampness, the dc common mode error is typically much less at lower relative humidity. If the common mode voltage is greater than 50 volts, the measurement should be made several minutes after hookup for best accuracy. This is due to the time required to charge stray capacitance through the extremely high resistance to ground.

2-36. MEASUREMENT OF NEGATIVE VOLTAGES

2-37. Because of the polarity switch, voltage which is negative with respect to common, as well as voltage which is positive, can be measured with equal facility. If the INPUT binding post is connected to ground, either at the front panel or at the source being measured, the accuracy of the voltmeter may be reduced. If the unknown voltage is negative, always connect the grounded side to the COMMON post, and use the polarity switch to obtain the proper result.

2-38. OFF-NULL DC INPUT RESISTANCE

2-39. At null on the two lowest dc ranges the input impedance of the instrument is infinite, since no current flows from the unknown. However, when the meter is off null on the two lowest ranges a small dc current will flow. The apparent dc input resistance on the 1 volt and 10 volt ranges for off-null meter deflection is given in Figure 2-5. The ac input impedance is, of course, 1 megohm in parallel with 40 pf.

2-40. NOTES ON MEASURING AC VOLTAGES

2-41. ERRORS DUE TO DISTORTION

2-42. The ac to dc converter in the 873A is an average responding device calibrated to rms. The converter will provide a dc output voltage that is proportional to 1.11 times the average value of the ac input voltage. Thus, if the input signal is not a true sinusoid, the 873A reading is probably in error because the ratio of rms voltage to average voltage is usually not the same in a complex wave as in a sine wave. The magnitude of the error is dependent on the magnitude of the distortion and on its phase and harmonic relationship to the funda-

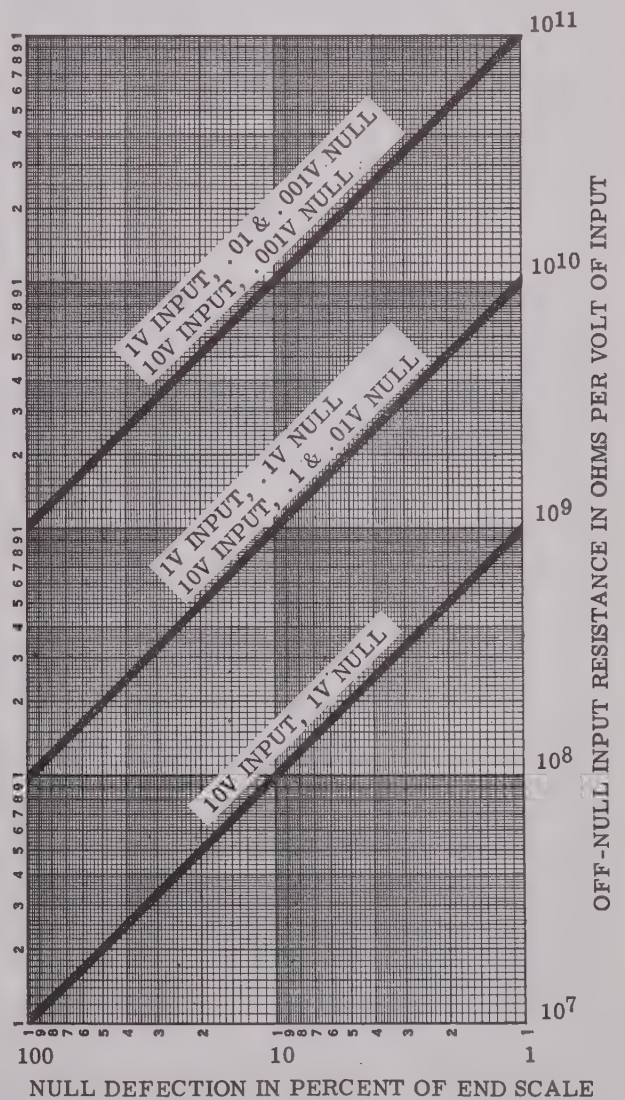


Figure 2-5. OFF-NULL INPUT RESISTANCE

mental. Figure 2-6 indicates how the accuracy is affected by various harmonics for different percentages of distortion. If the distortion present in the signal is composed of even harmonics and is less than 2%, the error between the 873A reading and true rms is fairly minor. A larger error can occur if the distortion is composed of odd harmonics, especially the third harmonic. Note that for 2% third harmonic distortion the error in the reading could range from 0 to 0.687%.

2-43. ERRORS DUE TO GROUNDING

2-44. In the 873A there is an 0.01 uf capacitor connected from the COMMON terminal to chassis ground. If the voltage to be connected to the COMMON terminal is not at ground potential, a line cord adapter must be used to isolate the 873A chassis from line ground. (The 873AB can be switched to battery operation.) Otherwise, the 0.01 uf capacitor will become an ac load on the circuit being measured.

Harmonic	% Distortion	% Error From True RMS*	
		Maximum Positive	Maximum Negative
Any even harmonic	0.1	0.000	0.000
	0.5	0.000	0.0001
	1.0	0.000	0.005
	2.0	0.000	0.020
Third harmonic	0.1	0.033	0.033
	0.5	0.167	0.168
	1.0	0.328	0.338
	2.0	0.667	0.687
Fifth harmonic	0.1	0.020	0.020
	0.5	0.099	0.101
	1.0	0.195	0.205
	2.0	0.380	0.420

*Error depends upon phase relationship between harmonic and fundamental, i.e. error can be any value between maximum positive and maximum negative, including zero.

Figure 2-6. PERCENT ERROR DUE TO HARMONIC DISTORTION

2-45. INTERNAL CONVERTER NOISE

2-46. When the instrument is shorted in the ac mode, the converter may produce a residual noise output of approximately 100 uv. This noise voltage will cause an insignificant error as long as ac input signals of 1 mv or larger are applied to the instrument. Figure 2-7 illustrates a typical half cycle of the signal voltage at the output of the converter amplifier. It is easily seen that the noise contributes very little to the average value of the signal and is well within the 2.7% accuracy of the instrument at 1 mv.

2-47. MOST SENSITIVE NULL RANGE

2-48. The most sensitive null range for each input range is labled DC ONLY, and is useful for measuring only dc voltages. Since the ac to dc converter provides a full-scale output of 1 volt, use of the last null switch position for ac measurements would require a full-scale null detector sensitivity of 100 uv. However, maximum full-scale sensitivity of the null detector is 1 mv. Consequently, switches S2, S3, and S4 are wired so that, for ac measurements, the null-detector input voltage is identical in the last two null switch positions. Usage of the last null position on ac (or on the 1 volt range for dc) yields no increase in null-detector sensitivity.

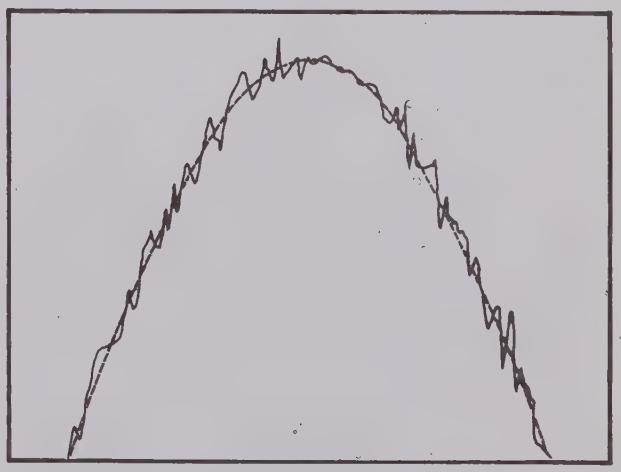


Figure 2-7. SIGNAL VOLTAGE WITH CONVERTER NOISE

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. GENERAL

3-3. A block diagram of the 873A/873AB AC/DC Differential Voltmeter is given in Figure 3-1. The main circuits in the instrument are an input attenuator, a dc transistorized voltmeter (tvm), an extremely accurate 0 to 11 volt dc reference, and an ac to dc converter. The input attenuator reduces the input voltage of the 100 and 1000 volt dc ranges. The tvm uses an attenuator and a high-sensitivity null detector. A Kelvin-Varley divider is used to adjust the reference voltage from 0 to 11 volts dc. The ac to dc converter changes the unknown ac voltage into an equivalent dc voltage. Refer to the functional schematic in the back of the manual for more detail. This schematic is intended to aid in understanding the circuit theory and in troubleshooting. The signal flow is from left to right, and the components are arranged functionally.

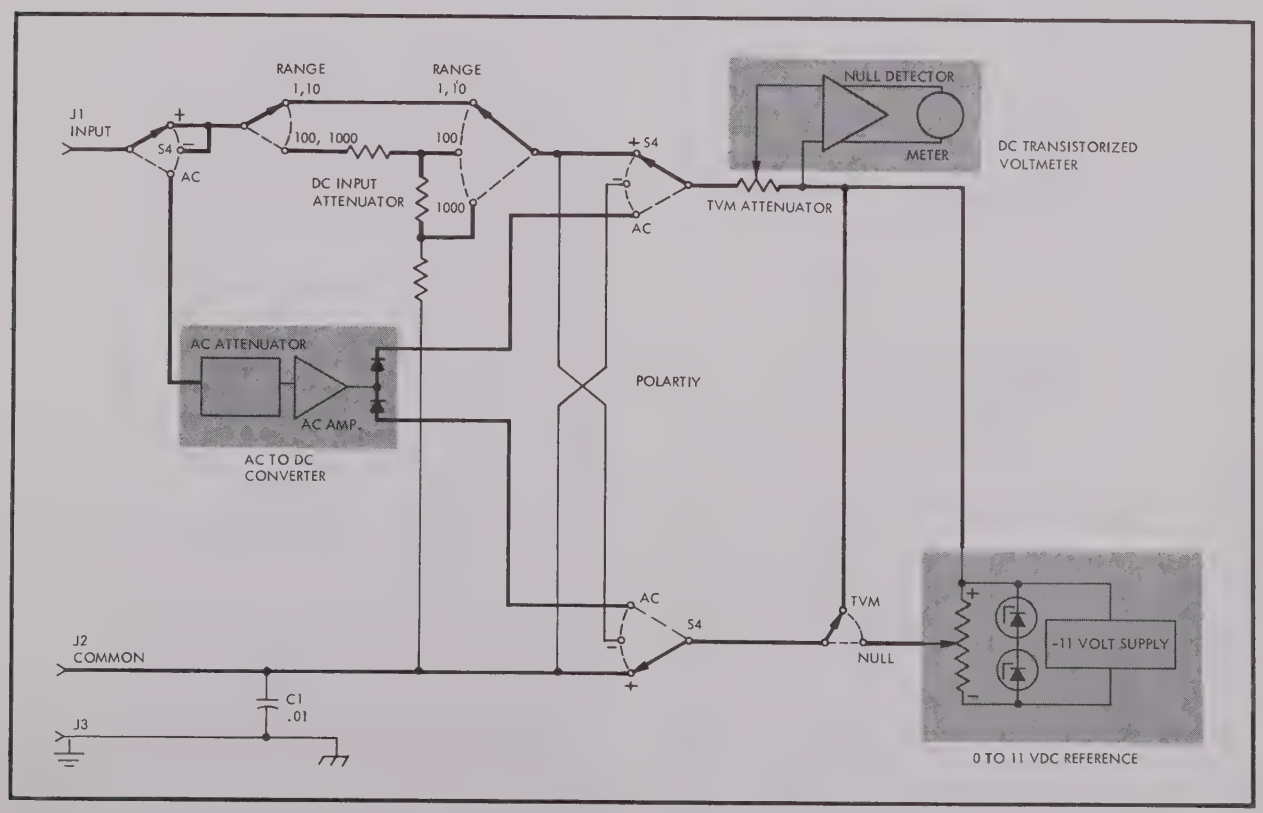


Figure 3-1. MODEL 873A AND 873AB BLOCK DIAGRAM

3-4. The overall operation of the instrument may be summarized as follows. To measure the approximate value of a dc voltage between 0 and 11 volts, the unknown voltage is connected directly across the tvm attenuator. The tvm attenuator reduces the full scale voltage in each range to 1 millivolt, which is the basic sensitivity of the null detector for full-scale meter deflection. The meter thus indicates the magnitude of the unknown voltage. To accurately measure the unknown dc voltage, it is connected across the series combination of the null detector and the 0 to 11 volt reference voltage. The reference voltage is then adjusted with the four voltage readout dials until it matches the unknown voltage as indicated by the null detector meter. The unknown voltage is then indicated by the four voltage dials. When measuring voltages between 11 and 1100 volts dc, the input attenuator divides the unknown voltage by 10 on the 100 volt range, and by 100 on the 1000 volt range. The instrument then operates essentially the same as for measurements of 0 to 11 volts. When measuring ac voltages, the unknown ac is first changed to an equivalent dc voltage in the ac to dc converter, which provides 1 volt dc output for full-scale ac input on any range. The equivalent dc voltage is then applied to the tvm attenuator, and measured the same as a dc voltage on the 1 volt dc range.

3-5. INPUT RESISTANCE OF INSTRUMENT

3-6. DC. For the tvm, low sensitivity, and medium low sensitivity null ranges, the input resistance of the tvm attenuator is 10 megohms (R1 through R6). For the medium high and high sensitivity null ranges, the input resistance of the tvm attenuator is 1 megohm (R3 through R6). However, this is not the input resistance of the 873A. For the 1 and 10 volt ranges, the input resistance is determined by dividing the unknown terminal voltage by the current drawn from the unknown. The current drawn from the unknown is equal to the difference between the unknown terminal voltage and the internally known voltage, divided by the resistance of the tvm attenuator. The equation for input resistance can therefore be written as:

$$R_{in} = \frac{E_u}{I_u} = \frac{E_u R_a}{|E_u - E|} = \frac{E_s (R_a + R_s)}{|E_s - E|} - R_s$$

where:

R_{in} = input resistance of voltmeter

E_u = $E_s - I_u R_s$ = terminal voltage of unknown

I_u = current drawn from unknown

E_s = source voltage of unknown

R_s = source resistance of unknown

R_a = input resistance of tvm attenuator

E = voltage indicated by voltage readout dials

$| \ |$ = absolute value (magnitude only)

Thus, the input resistance is essentially infinite (leakage resistance across input is in the order of 10^{12} ohms) at null when E is equal to E_u and E_s. For the 100 and 1000 volt range, the input attenuator is always connected across the input terminals. Thus, the input resistance is equal to the resistance of the input attenuator which is 10 megohms.

3-7. AC. The ac input impedance of the instrument is 1 megohm in parallel with 40 pf.

3-8. To provide a more complete understanding of the voltmeter, the following paragraphs describe each section of the circuit in more detail.

3-9. INPUT ATTENUATOR

3-10. Since the instrument contains a 0 to 11 volt reference, the unknown voltage is measured by comparing it directly to a known voltage with the aid of a null detector only on the 1 and 10 volt ranges. On the 100 and 1000 volt ranges, the input attenuator (R101 through R107) divides the unknown voltage by 10 and by 100, respectively, and this attenuated voltage is then measured the same as the 10 volt range. The input attenuator is extremely accurate and has excellent long term stability. The variable resistors R104 and R106 are used during calibration to set the correct division ratios.

3-11. DC TRANSISTORIZED VOLTMETER

3-12. GENERAL

3-13. The dc transistorized voltmeter (tvm) is composed of a tvm attenuator and a null detector. The heart of the dc tvm is the null detector in which the dc signal is modulated by a photochopper, amplified by a five stage amplifier, rectified by a transistor switch, and filtered to produce a dc output. High dc negative feedback makes the null detector relatively insensitive to gain variations in the individual transistors. The output of the null detector drives a meter with tautband suspension. The tautband eliminates the friction associated with pivot and jewel meters. Thus, any tendency for the meter pointer to stick at one point of the scale and then jump to another point is eliminated. The tvm attenuator reduces the applied voltage to 1 mv, the full-scale sensitivity of the null detector.

3-14. NULL-DETECTOR

3-15. The null detector is a current feedback amplifier that drives a meter. Any feedback amplifier is essentially a null seeking device. That is, it tends to make the voltage fed back to the input equal to the input voltage. In a current feedback amplifier, the feedback voltage is proportional to the output current. At the input to the 873A null detector, R201, C201, R202, and C202 form a double section low-pass filter that reduces any ac component present on the dc voltage being measured. The difference between the voltage appearing at the output of the filter and the voltage developed across feedback resistor R203 is converted to an alternating voltage by V201, a photochopper. The voltage across R203 is proportional to the current flowing in the meter. The alternating voltage created by V201 is amplified by a five-stage solid-state amplifier. The first stage is a

p-channel field effect transistor, Q201. The field effect transistor provides high input impedance and low noise. The next four stages consist of common-emitter amplification, with overall feedback from Q205 to Q202. A transistor switch, Q209, is gated in synchronization with V201. During the "off" portion of the photochopper cycle, the output of the amplifier is clamped to null detector common potential by Q209. During the "on" portion of the photochopper cycle, the output of the amplifier is filtered by R230 and C214 to provide a dc current for the meter. A portion of the current that flows through the meter is shunted back to the 200 ohm feedback resistor R203, thus completing the feedback loop. The gain of the null detector can be adjusted by means of R231 in the feedback network. The null detector has a basic sensitivity of 1 millivolt. However, to compensate for the loading effect of the tvm attenuator on the input attenuator, the full-scale sensitivity of the null detector is increased for the 100 and 1000 volt dc ranges according to the table below.

RANGE	NULL POSITION				
	TVM	LO	Med Lo	Med Hi	Hi
100 V	910uv	910uv	910uv	526uv	526uv
1000 V	1mv	1mv	1mv	910uv	910uv

3-16. TVM ATTENUATOR

3-17. In the tvm mode, one position on the tvm attenuator selected by range switch section S2G provides the necessary reduction of the 1 volt range for proper null detector input. Another position on the tvm attenuator is used for the 10, 100, and 1000 volt ranges because the input attenuator divides the input signal so as to reduce the 100 and 1000 volt ranges to the equivalent of the 10 volt range. In the null mode, the voltage difference (unknown voltage, or unknown voltage divided down, minus the reference voltage) is reduced as necessary by positions on the tvm attenuator selected by null switch sections S3H, S3G, and S3E to provide the basic null detector input of 1 millivolt.

3-18. PHOTOCHOPPER DRIVE CIRCUIT

3-19. Drive for the photochopper is obtained from a free-running multivibrator, Q206 and Q207. During the portion of the cycle that Q207 is on, Q208 is also on, which provides current through T201. When Q208 turns off, the flyback voltage of T201 illuminates neon lamp DS202. Transistor Q209 is driven in synchronization with DS202 through C213, transistor Q209 being off when DS202 is on. Resistor R218 is used to adjust the chopper frequency to 84 Hz, and resistor R219 is used to adjust the duty cycle of DS202. Resistor R227 is used to electrically zero the null detector.

3-20. INFLUENCE OF AC COMPONENTS

3-21. The only ac voltage component that will reduce the accuracy of dc measurements of the 873A is one that either saturates the null detector or that beats with the chopper frequency. Since the voltage required for saturation is greater than that required for beating, the null detector is most sensitive to an ac component with a frequency that is a submultiple or a low multiple of the chopper frequency. However, this is easy to detect because the meter will oscillate at the difference frequency. The low pass filter at the input of the chopper-amplifier will attenuate any ac component. The magnitude of the ac voltage appearing at the output of the filter depends on both its amplitude and frequency before filtering. For all practical purposes, one should never encounter any trouble above a hundred cycles. If ac components that affect accuracy are ever encountered, additional filtering as outlined in the operating instructions will eliminate the problem.

3-22. RECORDER OUTPUT

3-23. The recorder output is provided by R236, R7, and R237. Recorder output AMP ADJ control R7 provides for adjusting the recorder output voltage up to a maximum of at least 20 millivolts at full-scale deflection (1.0). The voltage at the RECORDER OUTPUT terminals is proportional to the meter deflection.

3-24. 0 TO 11 VOLT REFERENCE

3-25. GENERAL

3-26. In making differential voltage measurements between 0 and 11 volts, an internal reference voltage is nulled or matched against the unknown voltage. An extremely accurate reference voltage is therefore required. This is obtained from the 11 volt reference. The 0 to 11 volt reference is composed of a well regulated -16.5 volt power supply, a range divider, and a four decade Kelvin-Varley divider. The range divider reduces the voltage from a pair of Zener diodes in the -16.5 volt reference supply to 11 volts for the 10, 100, and 1000 volt ranges, and to 1.1 volts for the 1 volt range, before the reference voltage is applied to the Kelvin-Varley divider. The Kelvin-Varley divides the input reference voltage into 110,000 equal increments, thus providing an extremely accurate reference voltage.

3-27. -16.5 VOLT POWER SUPPLY

3-28. The -16.5 volt power supply uses diode CR101 and filter network R108-C101 to supply unregulated dc voltage to series pass transistor Q101. In the Model 873AB, unregulated dc voltage is supplied directly from batteries BT1 in the BAT CHECK and BAT OPR modes. The voltage is regulated by comparing a sample of the output voltage tapped off divider string R109, R110, and R111 with the voltage from Zener reference diodes CR103 and CR104 in a differential amplifier, Q102 and Q103. The output of the differential amplifier is amplified by Q104, which drives the base of series pass transistor Q101. The voltage drop across the series pass transistor, Q101, is continuously adjusted so as to maintain the two input voltages of the differential amplifier at the same level, and thus maintain the output voltage at a constant value. The -16.5 volt output is used to provide operating voltages for the null detector and for R117, which supplies a constant current to reference diodes CR103 and CR104. The voltage across the two Zener diodes may be between 12.0 and 13.0 volts, and has a stability better than 50 ppm per year and an overall temperature coefficient less than 5 ppm per °C.

3-29. RANGE DIVIDER

3-30. In the 1000, 100, and 10 volt dc ranges, the Zener reference voltage is connected to the Kelvin-Varley divider through resistors R118 and R119, and through switch sections S2J, S2I, S4G, and S4H. The voltage drop across R118 and R119 reduces the Zener reference voltage to 11 volts at the input of the Kelvin-Varley divider. In the 1 volt range, resistors R120, R121, and R122, selected by range switch sections S2J and S2I, reduce the voltage to 1.1 volts at the input to the Kelvin-Varley divider. When measuring ac voltages, the reference voltage of 1.1 volts is selected by switch sections S4G and S4H.

3-31. KELVIN-VARLEY DIVIDER

3-32. The four Kelvin-Varley decades composed of resistors R301 to R336, and the associated voltage dials A through D provide a means of reducing the reference voltages of 1.1 and 11 volts to the voltage indicated on the readout dials. The first decade has twelve 5K resistors. Two of these resistors are shunted by the 10K total resistance of the second decade. Between the two wipers of S301 (voltage dial A) there is thus a total resistance of 5K (10K paralleled by 10K). Thus, the first decade divides the voltage across it into eleven equal parts with one of the equal parts appearing across the two shunted resistors. Similarly, the second and third decades divide the voltage across their inputs into ten equal parts. The last decade is a variable resistor which sets the last 2 digits. With the null switch in any null range, the output of the Kelvin-Varley divider is connected in series with the null detector, thus providing an accurate reference voltage which opposes the input voltage.

3-33. AC TO DC CONVERTER

3-34. GENERAL

3-35. The ac to dc converter is composed of an attenuator, an operational amplifier, and a rectifier-filter circuit. Because the ac to dc converter is electrically isolated from the dc portions of the instrument, a separate auxiliary power supply is also required. The ac output of the amplifier is converted to dc by a rectifier-filter, which provides a dc voltage proportional to the average value of the ac input. The meter, however, is calibrated to indicate the rms value for a sine-wave input. The operational amplifier with high negative feedback makes the characteristics of the rectifier diodes linear and stable.

3-36. CONVERTER POWER SUPPLY

3-37. The auxiliary power supply for the converter is composed of Q507, Q508, Q509, and the associated components. Diode CR505 and filter network R534-C519 supply unregulated dc voltage to series pass transistor Q507. In the 873AB, unregulated dc voltage is supplied from a set of batteries, BT2, in the BAT CHECK and BAT OPR modes. The emitter voltage of Q509 is set by Zener diode CR506. The base input to Q509 is taken from a divider string, R538, R539, and R540, which samples the output voltage of the +18 volt supply. Any variation in the +18 volts varies the base drive of Q509, which varies the output from the collector load of Q509. Since the output of Q509 drives Q508, the collector current of Q508 continuously adjusts the conductance of Q507 to maintain the auxiliary voltage constant at the value determined by the setting of R539.

3-38. CONVERTER

3-39. The converter provides an output of 1 volt dc for full range ac input on any range. In the 1 volt range, the input ac is applied directly to the converter input. Input voltages on the 10, 100, and 1000 volt ranges are reduced by voltage dividers to the equivalent of the 1 volt range. The first amplification stage is an n-channel field-effect transistor, Q501. Use of the field-effect transistor, plus high negative feedback, provides high input impedance and low noise for the converter. Zener diode CR502 provides a stable voltage for bias adjustment of Q501. The output from Q501 is applied to two direct-coupled, common-emitter amplifiers, Q502-Q503, and Q504-Q506. The ac output from Q506 is rectified by CR503 and CR504, and filtered by R532-C517, and R533-C518, respectively, which provides the dc voltage equivalent to the converter input voltage. Since the diode rectifiers exhibit a high impedance at low signal levels, transistor Q505 is used to provide a high-impedance current drive for CR503 and CR504. Resistors R527, R528, and R529 provide a small voltage offset to compensate for a slight error voltage in the amplifier. Resistors R530 and R531 provide a feedback voltage proportional to the output current, which is applied to the feedback resistor R504. Due to the loading of the converter output resistance on the tvm attenuator, the full-scale sensitivity of the null detector is increased from 1 mv to 910 uv on the two most sensitive null ranges.

3-40. ADJUSTMENTS

3-41. The converter gain is adjusted with R503 in the feedback loop of the amplifier. The converter high-frequency response is adjusted by C502. The 10, 100, and 1000 volt attenuators are adjusted with R403, R406, and R409, respectively, for division ratio, and are adjusted with C402, C404, and C405, respectively, for high frequency response.

3-42. POLARITY SWITCH

3-43. The polarity switch S4, as seen in Figure 3-1, reverses the transistorized voltmeter - reference voltage combination with respect to the input for dc voltage measurements, and connects the output of the ac to dc convertor to the tvm attenuator for ac voltage measurements. Note that a 0.01 uf capacitor (C1) is connected from the COMMON post to the chassis ground post to reduce the effect of ac circulating currents. If the instrument did not contain a polarity switch, the grounded side of any unknown voltage that is negative with respect to ground would have to be connected to the INPUT post. This would ground the INPUT post and effectively place C1 across the input. With this capacitance connected across the circuit being measured several problems would arise. The polarity switch provides equal convenience in measuring positive and negative voltages without the occurrence of these problems.

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. Maintenance of the 873A series DC Differential Voltmeter should consist primarily of periodic cleaning and calibration. However, to determine if the instrument is within specifications, it is recommended that its performance be checked just before calibration by using the performance tests given in this section. Information on corrective maintenance is also included.

4-3. TEST EQUIPMENT

4-4. Figure 4-1 lists the recommended equipment and specifications required for performance testing, calibration, and corrective maintenance. If the recommended equipment is not available, other equipment which meets the required specifications may be used.

4-5. PERIODIC MAINTENANCE

4-6. Periodic maintenance consists primarily of occasional cleaning to remove dust, grease, and other contamination. Since the voltmeter is completely enclosed, the need for cleaning is reduced. Special care has been taken to prevent leakage across critical switch wafers, areas of some printed circuit boards, and from the printed circuit boards to chassis ground. The power, range, null, polarity, and all voltage readout switches are vacuum impregnated with silicone oil. These switches are also isolated from the chassis with Lexan spacers. The printed circuit boards are coated with a moisture sealant, and are isolated from chassis ground by means of polyethelene grommets.

4-7. To clean the instrument, proceed as follows:

CAUTION!

Avoid touching the polyethelene grommets. Contamination can cause excessive electrical leakage and/or voltaic effects.

a. Remove accumulations of dust with low-pressure, clean, dry air. Pay particular attention to the input binding posts, binding post wiring, switches, and polyethelene grommets which insulate the printed circuit boards from the chassis.

b. Clean polyethelene grommets, binding posts, and front panel with anhydrous denatured ethyl alcohol or an aerosol can of Freon TF Degreaser (Miller-Stephenson Chemical Co., Inc.) and, when necessary, a clean cloth or cotton swab.

CAUTION!

Do not use Metriclene, acetone, lacquer thinner, or any ketone, since they will react with the Lexan switch rotor. Also, be careful not to saturate the switch contacts, which have been lubricated for life.

c. When necessary, clean all exposed dielectric surfaces of switches with denatured alcohol, using a small, stiff-bristled brush which has been wrapped with a clean cloth to prevent saturating the switch contacts.

d. After cleaning, recoat exposed switch insulating material with silicon oil having a viscosity between 5 and 20 centistokes. This prevents leakage due to moisture on these surfaces.

4-8. PERFORMANCE TESTING

4-9. GENERAL

4-10. The following tests are designed to check the instruments performance against the specifications. The tests may be used as a routine maintenance procedure, and as an incoming inspection procedure. It is recommended that these performance checks be done just before calibration of the instrument. When used in this way, the performance tests provide a valuable case history on the characteristics of each instrument. Just prior to calibration, the instrument should be within specifications: if not, troubleshooting should be performed to eliminate the cause of the error before calibrating the instrument. Localizing the problem to a particular area of the instrument may be done by an analysis of the performance test results.

4-11. NULL DETECTOR SENSITIVITY TEST

4-12. The null detector is checked in this procedure by using the instruments internal reference supply and Kelvin-Varley divider. If the instrument fails to pass

RECOMMENDED EQUIPMENT	SPECIFICATIONS REQUIRED	USED FOR
VTVM, RCA Voltohmyst, or equivalent	Accuracy: ±3% dc ±5% ac Input Impedance: 10M Ω, dc 1M Ω, 5 pf, ac	TROUBLESHOOTING ELECTRONIC ADJUSTMENTS
Autotransformer, General Radio Model W5MT3 (Model W5HMT for 230 volt instruments), or equivalent.	103 to 127 volts (207 to 253 volts for 230 volt instruments)	TROUBLESHOOTING
DC Differential Voltmeter, Fluke Model 821A, or equivalent	Range: 500V, approximately Accuracy: ±0.01% Null Sensitivity: At least 1mv. Externally-adjustable reference voltage. 20ppm accuracy of Kelvin-Varley divider.	TROUBLESHOOTING
Standard Cell	Accuracy: ±.0005% Stability: ±.0004%	TROUBLESHOOTING
Oscilloscope, Hewlett-Packard Model 120B, or equivalent	Vertical sensitivity: 20 V/cm Sweep speed: 1 ms/cm, minimum	ELECTRONIC ADJUSTMENTS
Voltage Calibrator, Fluke Model 332A, or equivalent	Range: 0 to 1000 vdc Accuracy: ±0.005%, minimum (332A is ±0.003%)	PERFORMANCE TESTING CALIBRATION
Krohn-Hite Model LDS-1500 Oscillator	Range: 1 to 1000 vac 400 Hz, 10 kHz, and 20 kHz Accuracy: ±0.04%, less than 0.1% harmonic distortion	CALIBRATION
Fluke Model 540B Transfer Standard with A54-1 plug-in	Transfer accuracy: ±0.02% Range: 0 to 1000 volts	CALIBRATION
Fluke Model 910A RMS Voltmeter	RMS measurement of non-sinusoidal waveforms at 200 uv level.	ELECTRONIC ADJUSTMENTS.

Figure 4-1. TEST EQUIPMENT REQUIRED

this test, it may be due to a faulty reference supply or Kelvin-Varley divider. In this case, the measurement of an appropriate voltage in the tvm mode will indicate if the null detector is operating properly. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.
b. Check meter for electrical and mechanical zero according to paragraph 4-56.
c. Short INPUT post to COMMON post, and set polarity switch to + (positive).
d. Set switches on voltmeter as shown in Figure 4-2. The meter should indicate within 1-1/2 small scale divisions (±3% of null range) of the value shown in Figure 4-2.
e. Remove the short between INPUT and COMMON posts.

4-13. DIFFERENTIAL MEASUREMENT TEST

4-14. The following procedure checks the dc accuracy of the instrument with full input on each range and also with each voltage readout dial set to 1, 2, 3, 4, 5, 6, 7, 8, and 9 on the 10 volt range. This method checks the accuracy with a minimum number of measurements. Proceed as follows:

a. Set meter to zero with mechanical zero control, if necessary.
b. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup to equilibrium temperature (about 5 minutes).
c. Connect the 332A Voltage Calibrator, or equivalent, to the INPUT and COMMON binding posts of the voltmeter. Connect voltmeter COMMON post to line ground. The voltage source must provide 0 to 1000 volts dc, with a minimum accuracy of ±0.005% (332A is ±0.003%).

VOLTMETER SWITCH SETTINGS			
RANGE	NULL	VOLTAGE READOUT DIALS	METER INDICATION
10	1.0	1. 0 0 00	-1.0
10	.1	0. 1 0 00	-1.0
10	.01	0. 0 1 00	-1.0
10	.001	0. 0 0 10	-1.0
1	.1	.1 0 0 00	-1.0
1	.01	.0 1 0 00	-1.0
1	.001	.0 0 1 00	-1.0
100	10	1 0.0 00	-1.0
100	1	0 1.0 00	-1.0
100	.1	0 0.1 00	-1.0
100	.01	0 0.0 10	-1.0
1000	100	1 0 0. 00	-1.0
1000	10	0 1 0. 00	-1.0
1000	1	0 0 1. 00	-1.0
1000	.1	0 0 0. 10	-1.0
10	1	0. 1 0 00	-0.1
10	1	0. 2 0 00	-0.2
10	1	0. 3 0 00	-0.3
10	1	0. 4 0 00	-0.4
10	1	0. 5 0 00	-0.5
10	1	0. 6 0 00	-0.6
10	1	0. 7 0 00	-0.7
10	1	0. 8 0 00	-0.8
10	1	0. 9 0 00	-0.9
10	1	1. 0 0 00	-1.0
10	1	1. 1 0 00	-1.1

Figure 4-2. SETTINGS FOR NULL DETECTOR CHECK

d. Set NULL switch to 0.1, and set voltage readout dials to 1.00000.

e. Set RANGE switch to 1.

f. Set 332A for 1.00000 volts dc output.

g. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between .99969 and 1.00031.

h. Set RANGE switch to 10, NULL switch to 1, and voltage readout dials to 10.0000.

i. Set 332A for 10.0000 volts dc output.

j. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between 9.9969 and 10.0031.

k. Set RANGE switch to 100, NULL switch to 10, and voltage readout dials to 100.000.

l. Set 332A for 100.000 volts dc output.

m. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between 99.969 and 100.031.

n. Set RANGE switch to 1000, NULL switch to 100, and voltage readout dials to 1000.00.

o. Set 332A for 1000.00 volts dc output.

p. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between 999.69 and 1000.31.

q. Set RANGE switch to 10, and set NULL switch to .001.

r. Set 332A to output voltages listed in Figure 4-3. Set voltage readout dials on voltmeter as indicated for the applied voltage, and adjust the voltage readout dials for a null on the 873A meter. Final voltage readout dial settings should be within the values listed in Figure 4-3.

332A OUTPUT VOLTAGE	INITIAL 873A VOLTAGE READOUT DIAL SETTING	FINAL 873A VOLTAGE READOUT DIAL SETTING
1.111111	1.1111	1.1108 to 1.1114
2.222222	2.2222	2.2216 to 2.2228
3.333333	3.3333	3.3324 to 3.3342
4.444444	4.4444	4.4431 to 4.4457
5.555555	5.5555	5.5539 to 5.5571
6.666666	6.6666	6.6647 to 6.6685
7.777777	7.7777	7.7754 to 7.7800
8.888888	8.8888	8.8861 to 8.8915
9.999999	9.9999	9.9970 to 10.0028

Figure 4-3. VOLTAGE READOUT DIAL LIMITS

4-15. AC TO DC CONVERTER TEST

4-16. The following procedure checks the ac accuracy of the instrument at a specific frequency, assuming correct operation of the dc portions of the instrument. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.

b. Refer to Figure 4-4. Connect and adjust the necessary equipment to provide 10 volts ac ±0.04% at 10 kHz.

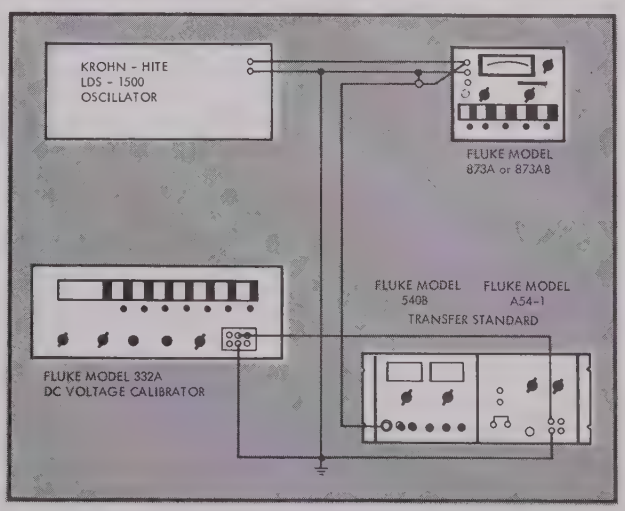


Figure 4-4. AC CALIBRATION SETUP

c. Set switches on voltmeter as follows:

RANGE	10
NULL	.1
polarity	AC
voltage readout dials	10.0000

d. Apply 10 volts at 10 kHz between INPUT and COMMON posts. Voltmeter should indicate within ±2.5 major divisions of null: if not, the ac to dc converter is out of tolerance, assuming correct operation of the dc portions of the instrument.

4-17. CALIBRATION

4-18. GENERAL

4-19. The calibration procedure is divided into two main parts: calibration of the dc differential voltmeter, and calibration of the ac to dc converter. The dc differential voltmeter portion of the instrument must be within specifications before calibration of the ac to dc converter. The 873A may be calibrated as often as deemed necessary; however, it is recommended that the dc differential voltmeter be calibrated every 6 months, and the ac to dc converter be calibrated every 2 months. Calibration should be performed under typical laboratory conditions of 72.5 (±2.5)°F in a draft-free area. Line voltage should be 115 (±2) volts, or 230 (±4) volts for 230 volt instruments. The equipment recommended and specifications required are given in Figure 4-1. All calibration controls are identified by decals inside the instrument.

4-20. CALIBRATION OF DC DIFFERENTIAL VOLTMETER

4-21. DC differential voltmeter calibration is divided into six parts: Preliminary Setup, Null Detector Calibration, 10 Volt Range Calibration, 1 Volt Range Calibration, 100 Volt Range Calibration, and 1000 Volt Range Calibration. Calibration is usually performed in the given sequence.

4-22. PRELIMINARY SETUP

a. Set meter to zero according to paragraph 4-56, if necessary.
b. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.
c. Connect the 332A Voltage Calibrator, or equivalent, to the INPUT and COMMON binding posts of the voltmeter. Connect voltmeter COMMON post to line ground. The voltage source must provide dc voltages of 0 to 1000 volts, with an accuracy of at least ±0.005% (332A is ±0.003%).

4-23. NULL DETECTOR CALIBRATION

a. Short INPUT post to COMMON post.
b. Set switches on voltmeter as follows:

RANGE	1
NULL	.001
voltage readout dials	.00100
polarity	+ (positive)

c. Adjust 1 mv gain control R231 for full-scale meter deflection to the left (-1.0), observed when the right side panel is replaced.
d. Remove the short between the INPUT and COMMON posts.

4-24. 10 VOLT RANGE CALIBRATION

Note!

The 10 volt range must be calibrated before attempting calibration of the 1, 100, or 1000 volt ranges. To prevent possible error due to leakage, use an insulated screwdriver to adjust R119, R121, R104, and R106.

a. Set switches on voltmeter as follows:

RANGE	10
NULL	1.0
voltage readout dials	10.0000
polarity	+ (positive)

b. Set 332A for 10.0000 volts output.
c. Adjust R119 for zero meter deflection in successively more sensitive null ranges. Resistor R111 may be adjusted if there is insufficient range in R119.

4-25. 1 VOLT RANGE CALIBRATION

a. Set switches on voltmeter as follows:

RANGE	1
NULL	.1
voltage readout dials	1.00000
polarity	+ (positive)

b. Set 332A for 1.00000 volt output.
c. Adjust R121 for zero meter deflection in successively more sensitive null ranges. The right side panel must be on the instrument when making this adjustment.

4-26. 100 VOLT RANGE CALIBRATION

a. Set switches on voltmeter as follows:

RANGE	100
NULL	10
voltage readout dials	100.000
polarity	+ (positive)

b. Set 332A for 100.000 volts output.
c. Adjust input attenuator R104 for zero meter deflection in successively more sensitive null ranges.

4-27. 1000 VOLT RANGE CALIBRATION

a. Set switches on voltmeter as follows:

RANGE	1000
NULL	100
voltage readout dials	1000.00
polarity	+ (positive)

b. Set 332A for 1000.00 volts output.
c. Adjust input attenuator R106 for zero meter deflection in successively more sensitive null ranges.

4-28. CALIBRATION OF AC TO DC CONVERTER

4-29. The dc differential voltmeter section of the instrument must be within specifications before the ac to dc converter can be accurately calibrated. The ac to dc converter must be calibrated in the following sequence.

4-30. PRELIMINARY CALIBRATION PROCEDURE

a. Zero instrument according to paragraph 4-56, if necessary.
b. Set switches on voltmeter as follows:

RANGE	1
NULL	TVM
polarity	AC
voltage readout dials	1.00000

c. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.
d. Connect and adjust the necessary equipment to provide 100, 10, and 1 volts at 400 Hz and at 20 kHz with an amplitude accuracy of 0.04%: and 500 volts at 400 Hz and 10 kHz with an amplitude accuracy of 0.04%. All voltages must have less than 0.1% total harmonic distortion. The required voltages can be obtained as follows:
e. Connect equipment as shown in Figure 4-4. Turn on all equipment and allow it to warmup for about 1/2 hour. Set 332A output voltage to the rms value of the required ac voltage. Apply output of 332A to 540B and null galvanometer by adjusting 540B internal reference supply. Apply output of ac oscillator to 540B and null galvanometer by adjusting ac oscillator voltage. The oscillator output now equals the required ac voltage.
f. Remove top cover of voltmeter.

4-31. GAIN ADJUSTMENT AT 1 VAC

a. Apply 1 volt at 400 Hz between INPUT and COMMON posts.
b. Set NULL switch to .001.
c. Adjust R503 until meter needle is within ±200 microvolts (2 major divisions) of null when top cover is replaced.

4-32. HIGH FREQUENCY ADJUSTMENT AT 1 VAC

a. Apply 1 volt at 20 kHz between INPUT and COMMON posts.
b. Adjust C502 until meter needle is within ±200 microvolts (2 major divisions) of null when top cover is replaced.

4-33. ATTENUATOR ADJUSTMENT AT 10 VAC

a. Set RANGE switch to 10, and set NULL switch to TVM.
b. Apply 10 volts at 400 Hz between INPUT and COMMON posts.
c. Set NULL switch to .01.
d. Adjust R403 until meter needle is within ±2 millivolts (2 major divisions) of null when top cover is replaced. Note that 10, 100, and 1000 volt attenuator controls and 10, 100, and 1000 volt high frequency adjust controls are located from left to right, respectively, on bracket next to converter board.

4-34. HIGH FREQUENCY ADJUSTMENT AT 10 VAC

a. Apply 10 volts at 20 kHz between INPUT and COMMON posts.
b. Adjust C402 until meter needle is within ±2 millivolts (2 major divisions) of null when the top cover is replaced.

4-35. ATTENUATOR ADJUSTMENT AT 100 VAC

a. Set RANGE switch to 100 and set NULL switch to TVM.
b. Apply 100 volts at 400 Hz between INPUT and COMMON posts.
c. Set NULL switch to .1.
d. Adjust R406 until meter needle is within ±20 millivolts (2 major divisions) of null when the top cover is replaced.

4-36. HIGH FREQUENCY ADJUSTMENT AT 100 VAC

a. Apply 100 volts at 20 kHz between INPUT and COMMON posts.
b. Adjust C404 until meter needle is within ±20 millivolts (2 major divisions) of null when the top cover is replaced.

4-37. ATTENUATOR ADJUSTMENT FOR 1000 VAC

a. Set RANGE switch to 1000 and set NULL switch to 1.
b. Set voltage readout dials to 500.00.
c. Apply 500 volts at 400 Hz between INPUT and COMMON posts.
d. Adjust R409 until meter needle is within ±100 millivolts (1 major division) of null when the top cover is replaced.

Note!

If preferred, 1000 volts at 400 Hz may be used by adjusting R410 until meter needle is within ±200 millivolts (2 major divisions) of null with 1000 volts applied.

4-38. HIGH FREQUENCY ADJUSTMENT FOR 1000 VAC

a. Apply 500 volts at 10 kHz between INPUT and COMMON posts.
b. Adjust C405 until meter needle is within ±100 millivolts (1 major division) of null when the top cover is replaced.

Note!

If preferred, 1000 volts at 10 kHz may be used by adjusting C405 until meter needle is within ±200 millivolts (2 major divisions) of null with 1000 volts applied.

4-39. CORRECTIVE MAINTENANCE

4-40. GENERAL

4-41. Since the 873A AC/DC Differential Voltmeter is a completely transistorized instrument, the possibility of component failure is reduced. Under normal circumstances, the only thing that will interfere with the operation of the instrument is the need for calibration. However, if the instrument does not perform correctly before or after calibration, the technician may use the information given here as a guide for locating and correcting the source of trouble. All equipment required for maintaining the instrument is listed in Figure 4-1.

4-42. TROUBLESHOOTING

4-43. The purpose of troubleshooting is to quickly and accurately correct the cause of any abnormal condition. Thus, servicing should begin with an attempt to localize the general area of trouble. By performing a complete performance check as outlined in paragraph 4-8, the trouble may be isolated to the null detector, reference supply, Kelvin-Varley divider, input attenuator, or ac to dc converter. To assist in localizing some of the more common troubles that may occur, the causes and remedies for a number of malfunctions are listed in the troubleshooting chart, Figure 4-5. However, an understanding of the circuit theory and frequent reference to the schematic diagram is the best way to locate the cause of any trouble.

4-44. VISUAL INSPECTION. Trouble can sometimes be found by a thorough visual inspection. Look for:

a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in periodic maintenance, paragraph 4-7.

b. Scorched or burned parts. Damage of this type is usually due to a defective component. Determine cause of damage before replacing overheated part.

SYMPTOM	PROBABLE CAUSE	REMEDY
Drift of reference supply, evidenced by meter needle drift	R109, R110, R114, R115, R117, R118, R120, or R122 changing value with temperature change.	Locate faulty resistor by heating with a soldering iron held near resistor, while making a standard cell measurement. Meter drift will indicate faulty resistor.
	Faulty Zener diode	Monitor voltage across Zener diode pair. If Zener voltage drifts, replace Zener diodes, and R118.
	Q101, Q102, Q103, or Q104 defective.	Check, and replace if necessary.
Meter rattle or drift	Dirty or defective FET, Q201.	Clean input to Q201. Vary operating point slightly with R209, or replace.
	Dirty lucite rod	Clean
	Faulty DS202	Check by replacement
	Faulty C206	Check by replacement
	Moisture, dirt, or other contamination on printed circuit boards, or switches	Clean instrument according to paragraph 4-7.
	Faulty Zener diode	Monitor voltage across Zener pair. Replace if rattle exceeds 50 ppm peak-to-peak.
Measurements are out of tolerance on every range except at full scale	One of the Kelvin-Varley resistors is out of tolerance	Check accuracy of Kelvin-Varley divider according to paragraph 4-50.
	Leakage from Null Detector to ground	Clean instrument according to paragraph 4-7.
Meter beats with voltage being measured.	Chopper drive circuit out of adjustment.	Adjust photochopper drive frequency according to paragraph 4-54.

Figure 4-5. TROUBLESHOOTING CHART

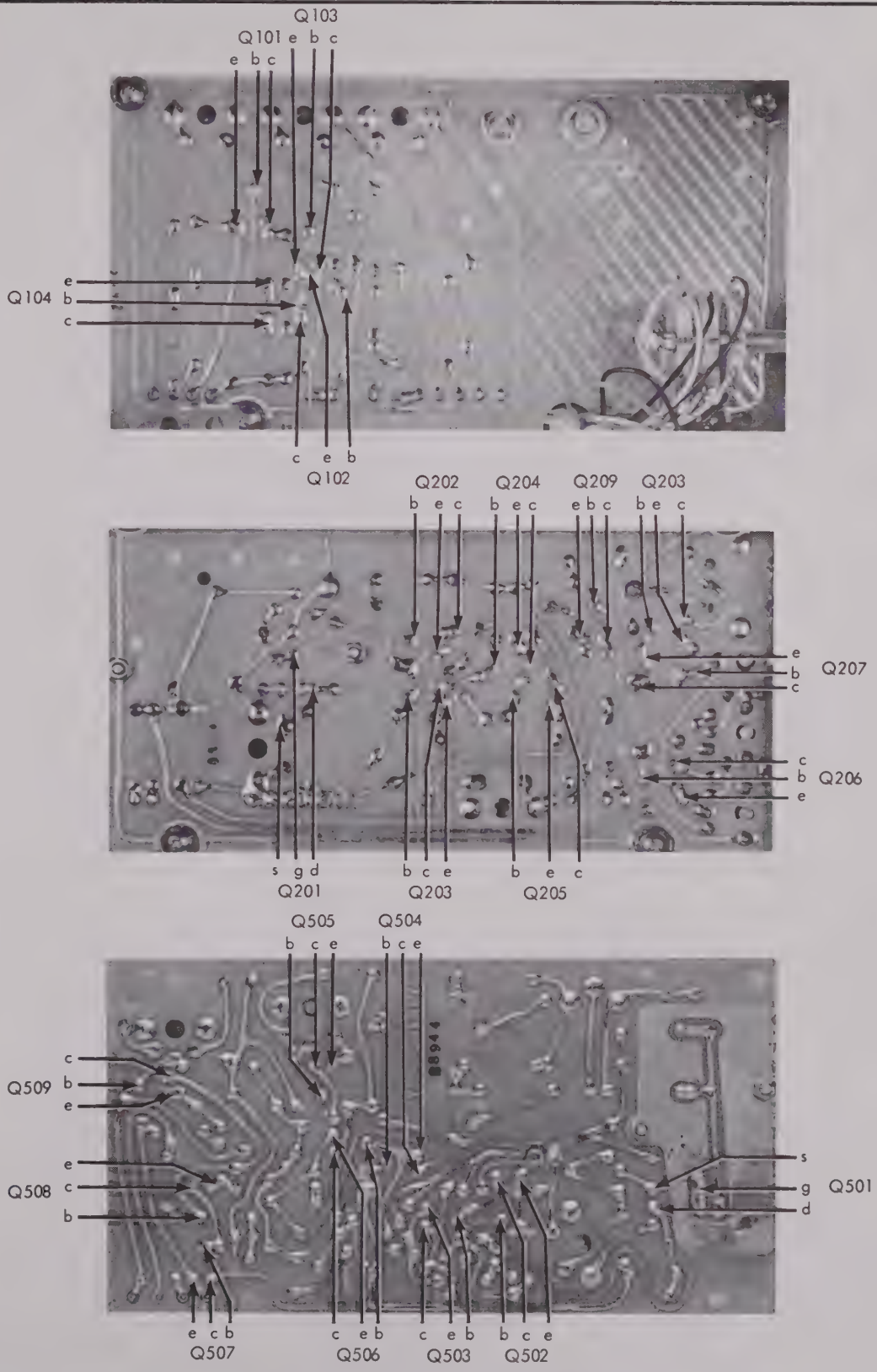


Figure 4-6. LOCATION OF TRANSISTOR TERMINALS

CAUTION!

Avoid touching the polyethelene grommets. Contamination can cause electrical leakage and/or voltaic effects.

c. Cracks, cuts, and other damage to polyethelene grommets. Replace grommets, using a plastic bag over the hand to prevent contamination.
d. Input divider resistors (R101, R102, R103, R105, and R107) touching the printed circuit board. When these resistors touch the circuit board, leakage paths are created which can result in error.
e. Loose or intermittent connections.

4-45. VOLTAGE LEVEL CHECKING. When the trouble has been localized to a stage, the defective part may be isolated by voltage level measurements at the transistor terminals. Transistor terminals are identified in Figure 4-6. When making measurements on printed circuit boards, use a sharp probe and press firmly while rotating the probe to break through the insulating coating. Measurements that differ widely from those listed in the transistor voltage chart, Figure 4-7, can be used to isolate the defective part in most cases.

CAUTION!

When measuring pin voltages, it is recommended that care be used to prevent momentary short circuits which could damage transistors.

4-46. TROUBLESHOOTING CHECKS. The following troubleshooting checks list several checks that can be performed on the instrument. The most probable cause of an abnormal condition is also given.

TRANSISTOR	EMITTER (vdc)	BASE (vdc)	COLLECTOR (vdc)
Q101	-27.2 ①	-26.2	-16.6 ②
Q102	-13.4	-13.0	- 6.9
Q103	-13.4	-13.0	0
Q104	- 6.3	- 6.9	-26.2
Q201	0 to - 5.0 (SOURCE)	0 (GATE)	-5 to -11 (DRAIN)
Q202	0	- .5	- .6
Q203	0	- .6	- 1.9
Q204	- 1.6	- 1.9	- 3.0
Q205	- 3.0	- 3.6	- 8.3
Q206	-16.6	-21.2	- 6.6
Q207	-16.6	-18.5	-11.7
Q208	-16.6	-16.6	- 3.6
Q209	0	+ 2.0	0
Q501	6.9 (SOURCE)	5.1 (GATE)	11.1 (DRAIN)
Q502	0	0.7	3.1
Q503	2.4	3.1	9.6
Q504	0	.7	3.7
Q505	10.8	11.4	18.1
Q506	2.9	3.7	9.1
Q507	35.4 ③	34.9	18.1 ④
Q508	1.8	2.2	34.9
Q509	6.5	6.0	2.2

The above operating voltage levels are measured under the following conditions: (a) line voltage at 115/230 vac, 50 to 440 Hz; (b) all voltages measured with a 3%, 10 megohm voltmeter from specified terminal to common of circuit being measured. The COMMON post is reference supply-null detector common when in TVM mode or when in a NULL mode with all voltage dials set to 0 and polarity switch set to +; the COMMON post is ac to dc converter common when polarity switch is set to AC. (c) some voltages may vary as much as 20%, however, bias voltages (difference between emitter and base voltages) should remain approximately the same. NOTES: ① Emitter of Q101 should be between -26 and -35 vdc for 115/230 vac line operation, between -19.5 and -21.0 vdc for BAT OPR (873AB only), and not less than -23.5 vdc for BAT CHG (873AB only) as measured with a VTVM. ② Collector of Q101 should be between -15.8 and -17.9 vdc as measured with a VTVM. ③ Emitter of Q507 should be between +26 and +35 vdc for 115/230 vac line operation, between +19.5 and +21 vdc for BAT OPR (873AB only), and not less than +23.5 vdc for BAT CHG (873AB only) as measured with a VTVM. ④ Collector of Q507 should be between +16.5 and +19.5 vdc as measured with a VTVM. To prevent damaging the transistor, use care when measuring near Q507.

Figure 4-7. TRANSISTOR VOLTAGE CHART

4-47. Meter Rattle Check. If the meter needle appears to rattle excessively, perform the following check:

a. Set switches on voltmeter as follows:

RANGE	1
NULL	.001
voltage readout dials	zero
polarity	+ (positive)

b. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow a warmup period of 5 minutes.
c. Short INPUT post to COMMON post. Random excursions of meter needle should be less than 1/4 small division peak-to-peak. If rattle is excessive, check field-effect transistor Q201 by replacement, or by slightly varying the operating point of Q201 with R209.

4-48. Reference Voltage Regulation. If regulation of the reference voltage is suspected of being faulty, perform the following check:

a. Connect an autotransformer to line power. A high-quality ground must be provided for the autotransformer.
b. Connect 873A line cord to output of autotransformer.
c. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow a warmup period of 5 minutes.
d. Set autotransformer to 103 volts (207 volts when voltmeter is wired for 230 volt operation) as measured with a VTVM.
e. Set NULL switch to TVM.
f. Set polarity switch to + (positive).
g. Connect a differential voltmeter between the COMMON post and the base of Q103, and record the voltage measured.
h. Set the autotransformer to 127 volts (253 volts when voltmeter is wired for 230 volt operation). Voltage indication of differential voltmeter should change by less than 200 uv from step g. If regulation is poor, it is probably due to excessive load current from the reference supply to the null detector.

4-49. Common Mode Measurement Check. If the instrument is suspected of making incorrect measurements in the presence of common mode voltages, perform the following check:

a. Measure the voltage of a standard cell, using the 1 volt range and positive polarity. The standard cell must be floating.
b. Connect 500 vdc from chassis ground post to COMMON post, and wait for 3 minutes.
c. Measure standard cell voltage. If the two measurements differ by more than 50 microvolts, there is excess electrical leakage to ground. Clean instrument according to paragraph 4-5.

4-50. Kelvin-Varley Divider Check. The Kelvin-Varley divider check requires a connection to the Kelvin-Varley divider inside the instrument. Proceed as follows:

a. Remove bottom panel.
b. Locate input-output common wire. This is the black wire connected to the bottom of S301 (voltage dial A).
c. Jumper from the input-output common wire located in step b. to the 821A common post.
d. Connect the INPUT post to the 821A input post.
e. Set 873A switches as follows:

RANGE	10
NULL	Any null range
polarity	- (negative)
voltage readout dials	10.0000

f. Set 821A polarity switch to - (negative).
g. Set 821A voltage readout dials to 9.9910. With operate-calibrate control set to operate, adjust 821A calibrate control for zero meter deflection in most sensitive null range.
h. Set the 873A and 821A readout dials to the values given in Figure 4-8. The panel meter of the 821A should indicate within the maximum deviation column of Figure 4-8 for each step. If the Kelvin-Varley divider is out of tolerance, a resistor is defective and must be replaced.

4-51. ELECTRONIC ADJUSTMENTS

4-52. The following electronic adjustments may occasionally be required.

4-53. ADJUSTMENT OF -16.5 VOLT SUPPLY. Resistor R111 usually requires adjustment when a part is replaced in the -16.5 volt power supply. Resistor R111 is adjusted, if necessary, by performing the 10 volt and 1 volt range calibration (paragraphs 4-24 and 4-25).

4-54. PHOTOCHOPPER FREQUENCY ADJUSTMENT. The photochopper frequency should be adjusted if a part is replaced in the drive circuit, if there is difficulty in zeroing the meter, or if line operation causes the meter to beat with the voltage being measured. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB or to ON with 873A.
b. Set NULL switch to TVM, and set polarity switch to + (positive).
c. Connect oscilloscope between COMMON post and collector of Q208 (test point 1).
d. Set oscilloscope controls as follows:

Vertical sensitivity	20v/cm
Trigger mode	Automatic
Trigger slope	"Int (+)"
Time	2 milliseconds/cm

e. Adjust R218 for a 12 millisecond drive period.
f. Adjust R219 for a duty period of 4 milliseconds.
g. Since R218 and R219 interact slightly, repeat steps e. and f.

4-55. BIAS ADJUSTMENT OF FIELD-EFFECT TRANSISTORS. The bias of field-effect transistors Q201 and Q501 may require adjustment if the transistors, or a component in their respective source-drain circuits is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A.
b. Set NULL switch to TVM.

871A Voltage Dial Settings	821A Voltage Dial Settings	Maximum Deviation ± microvolts for 11 vdc in
100000	99910	1000
999100	99910	1000
90000	9000	900
899100	9000	900
80000	8000	800
799100	8000	800
70000	7000	700
699100	7000	700
60000	6000	600
599100	6000	600
50000	5000	500
499100	5000	500
40000	4000	400
399100	4000	400
30000	3000	300
299100	3000	300
20000	2000	200
199100	2000	200
10000	1000	100
099100	1000	100
09000	0900	100
089100	0900	100
08000	0800	100
079100	0800	100
07000	0700	100
069100	0700	100
06000	0600	100
059100	0600	100
05000	0500	100
049100	0500	100
04000	0400	100
039100	0400	100
03000	0300	100
029100	0300	100
02000	0200	100
019100	0200	100
01000	0100	100
009100	0100	100
00900	0090	100
008100	0090	100
00800	0080	100
007100	0080	100
00700	0070	100
006100	0070	100
00600	0060	100
005100	0060	100
00500	0050	100
004100	0050	100
00400	0040	100
003100	0040	100
00300	0030	100
002100	0030	100
00200	0020	100
001100	0020	100
00100	0010	100
000100	0010	100

Figure 4-8. KELVIN-VARLEY DIVIDER ERROR LIMITS

c. Measure voltage across Q201 (test point 2 to test point 3) with a VTVM.
d. Adjust R209 so that VTVM indicates 6 volts.
e. Connect VTVM from drain of Q501 (see Figure 4-6) to COMMON post.
f. Set polarity switch to AC.
g. Adjust R507 so that VTVM indicates +11 (±0.5) volts.

4-56. NULL DETECTOR ZERO. If the meter deflects off-null, after being mechanically zeroed with the meter terminals shorted, the null detector is out of electrical zero, and needs adjustment. Proceed as follows:

a. Short INPUT post to COMMON post.
b. After 3 minutes, zero the meter mechanically.
c. Set switches on voltmeter as follows:

RANGE	1
NULL	.001
polarity	+ (positive)
voltage readout dials	zero

d. Meter offset should be less than 1/4 small scale division when the polarity switch is rotated; if not, adjust R227 as necessary to zero the meter.
e. Remove the short from the input: meter offset should remain within 1/3 small scale division in both dc polarities.

4-57. CONVERTER SUPPLY CHECK AND ADJUSTMENT. Resistor R539 may require adjustment if a part is replaced in the +18 volt supply. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A.
b. Connect a VTVM across C522. Also connect the 910A rms voltmeter across C522.
c. Adjust R539 so that the VTVM indicates +18 (±0.1) volts dc. Ripple indicated by the 910A should not exceed 200 microvolts rms.

4-58. ADJUSTMENT OF CONVERTER OUTPUT. The converter output level may require adjustment if Q506 or an associated part is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A.
b. Connect a VTVM from the collector of Q506 to the COMMON post.
c. Set the polarity switch to AC.
d. Adjust R521 so that VTVM indicates 9.5 (+0.5, -1.5) volts. Adjustment to 9.5 volts from the upper limit is usually easier.

4-59. MECHANICAL DRUM ADJUSTMENTS

4-60. Occasionally the need may arise to align the polarity switch drum or one of the voltage dial drums in the readout windows. Also, if the drive gear on a switch or dial shaft is no longer in line with the drum shaft, the gears may bind as the dials are rotated. Align as follows:

a. Remove both side front-covers and the bottom cover from 873A.

b. Stand instrument on rear.

c. Make sure that drive gear on polarity switch shaft and drive gear on shaft of voltage dial D are in line with drum shaft. If not, loosen set screw of drive gear with a 1/16" hex key and align drive gear with drum shaft.

d. Loosen adjusting bracket at left side of instrument and position drum shaft up or down until there is just discernible backlash. That is, until polarity drum just moves when rotated with a finger without moving drive gear on polarity switch shaft.

e. Loosen adjusting bracket at right side of instrument and position drum shaft until there is just discernible backlash for drum of voltage dial D.

f. Turn polarity switch and all voltage dials fully counterclockwise.

g. Loosen set screw of drive gear for drum being aligned and slide drive gear toward back of instrument.

Note!

See step l. for adjustment of voltage dial D.

h. Insert finger through window and hold drum being aligned in desired position.

i. Insert hex key into set screw of drive gear and lift drive gear into place allowing it to turn counterclockwise as the teeth mesh.

j. When drive gear is in line with drum shaft tighten set screw.

k. Check character alignment in window. If necessary, loosen set screw and rotate drive gear slightly for final adjustment.

l. To align drum for voltage dial D, loosen set screw of drive gear and slide toward rear of instrument.

m. Insert hex key into set screw of drive gear and lift drive gear into alignment with drive shaft while noting how much drum turns.

n. Slide drive gear toward rear of instrument.

o. Position drum so that oo position will line up with pointer when gear is raised into position.

p. Raise drive gear into alignment with drum shaft and position 00 in line with pointer by rotating drive gear slightly before tightening set screw.

SECTION V

LIST OF REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section contains information necessary to describe all normally replaceable parts. Separate assembly lists are used to describe the parts on the final assembly and various assemblies and subassemblies. Each list has a corresponding illustration on which the parts for that list are identified. Parts are called out on both lists and illustrations by reference designations from the schematic diagram. Those parts (mechanical) which have no reference designation are shown on the illustrations by Fluke stock number.

5-3. Each list provides the following information on each part:

a. The REF DESIG. column indicates the reference designation used on the schematic diagram.

b. The DESCRIPTION column describes the part in words, along with any applicable values, tolerances, etc. Indentation is used to show assembly, subassembly, and parts relationship. See abbreviations and symbols on next page.

c. Entries in the FLUKE STOCK NO. column indicate the number by which Fluke stocks the part. This number should be used when ordering parts from the Fluke factory or your Fluke representative.

d. Entries in the MFR. column indicate a typical manufacture of the part by the manufacturer's code number. Appendix A lists the manufacturers and their code numbers.

e. Entries in the MFR. PART NO. column are part numbers assigned by the manufacturer indicated in the Mfg. column.

f. The number in the TOT. QTY. column indicates the total quantity of the part used in the instrument. "REF" indicates that the total quantity of the part has been previously given. The total quantity of each part is listed the first time the part appears. All other listings of the same part refer back to the reference designation of the first appearance of the part for the total quantity.

g. The number in the REC. QTY. column indicates the recommended spares quantity necessary to support approximately one to five instruments for a period of two years. The basis used to select the recommended spares quantity is that a small group of parts will be required to correct a majority of the problems that occur. Since there is a chance that any part may fail, a stock of at least one of every part used in addition to the recommended parts will be needed for complete maintenance during one year of isolated service.

h. The USE CODE column identifies certain parts which have been added, deleted, or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List at the end of this section. These changes are normally made when improved components become available or when the latest circuit improvements are developed by our engineering department. The serial number listed indicates the instruments in which that particular part was used. The symbol "~" is used to indicate an approximate use code. If a different part should be used for replacement, it is listed by Fluke stock number in the description column.

5-4. HOW TO OBTAIN PARTS

5-5. Standard components have been used whenever possible. Thus, most parts can be obtained locally. However, parts may be ordered directly from the manufacturer using the manufacturer's part number or from Fluke using the Fluke stock number. In addition, the most commonly replaced parts that can not be obtained locally may be obtained from your Fluke representative. If a part you have ordered has been replaced by a new or improved part, Fluke will normally send you this part along with an explanation.

5-6. When ordering parts from Fluke always include:

a. Reference designation, description, and Fluke stock number.

b. Instrument model and serial number.

c. Most structural parts are not listed. In this case, give complete description, function, and location of part.

5-7. ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

ac	alternating current	mw	milliwatt
Al	aluminum	na	nanoampere
assy	assembly	pf	picofarad
cap	capacitor	piv	peak inverse voltage
car flm	carbon film	plstc	plastic
cer	ceramic	pp	peak-to-peak
comp	composition	ppm	parts per million
conn	connector	rect	rectifier
cps	cycles per second	res	resistor
db	decibel	rms	root-mean-square
dc	direct current	sb	slow-blow
dpdt	double pole double throw	Si	silicon
dpst	double pole single throw	S/N	serial number
elect	electrolytic	sw	switch
fxd	fixed	spdt	single pole double throw
Ge	germanium	spst	single pole single throw
gmv	guaranteed minimum value	Ta	tantalum
Hz	hertz (cycles per second)	tc	temperature coefficient
K	kilohm	tstr	transistor
kc or Kc	kilocycle	ua	microampere
kHz or KHz	kilohertz (kilocycles per sec)	uf	microfarad
kv	kilovolt	uv	microvolt
kva	kilovolt-ampere	va	volt ampere
ma	milliampere	vac	alternating current volts
Mc or MC	megacycle	var	variable
MHz	megahertz (megacycles per sec)	vdc	direct current volts
meg or M	megohm	w	watt
met flm	metal film	wvdc	direct current working volts
mfg	manufacturer	ww	wirewound
mv	millivolt		

PREFIX SYMBOLS

T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
K or k	kilo	10^{3}
h	hecto	10^{2}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
u	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	anto	10^{-18}

QUANTITY SYMBOLS

a or amp	ampere
f	farad
h	henry
hr	hour
Ω	ohm
sec	second
v or V	volt
w or W	watt

SPECIAL NOTES AND SYMBOLS

~ Approximate use code, or serial number.

Use 0000-000000 Part number indicated should be used if replacement is required.

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Final Assembly (see Figure 5-1)						
	(Line-powered model)	873A	89536				
	(Battery/line-powered model)	873AB	89536				
	Front Panel Assembly (see Figure 5-2)				1		
	(873A)	3158-169029	89536	3158-169029			
	(873AB)	3158-169169	89536	3158-169169			
	Wiring Assembly (see Figure 5-3)				1		
	(873A)	3158-169037	89536	3158-169037			
	(873AB)	3158-169177	89536	3158-169177			
	Reference Supply Assembly (see Figure 5-4)	1702-167684	89536	1702-167684	1		
	Null Detector Assembly (see Figure 5-5)	1702-167676	89536	1702-167676	1		
	Kelvin-Varley Resistor Assembly (see Figure 5-6)	3158-167668	89536	3158-167668	1		
	Attenuator PCB Assembly (see Figure 5-7)	1702-169011	89536	1702-169011	1		
	Converter Assembly (see Figure 5-8)	1702-169003	89536	1702-169003	1		
C2	Cap, plastic, 0.47 uf ±20%, 1000V	1507-161612	14752	210B1G474	1		
C4	Cap, plastic, 0.01 uf ±20%, 1000V (not illustrated)	1509-159996	84411	663UW103010W	2		D
F1	Fuse, 1/16 amp, 125V, slow-blowing (115V operation of 873A)	5101-163030	03614	Type MDL	1	3	
	Fuse, 1/32 amp, 250V, slow-blowing (230V operation of 873A)	5101-163022	03614	Type MDL	1	3	
	Fuse, 1/8 amp, 250V, slow-blowing (115V or 230V operation of 873AB)	5101-166488	03614	Type MDL	1	3	
J4, J5	Binding post, red	2811-142976	58474	DF31RC	4		
J6	Jack, line cord, 3 pin	2109-160275	73586	M-1550-Gs	1		
R7	Res, var, comp, 10K ±10%, 1/2W	4701-162800	12697	Series 37	1		
R10	Res, comp, 10M ±10%, 1/2W (not illustrated)	4704-108142	01121	EB1061	1		
T1	Transformer, power	5602-169342	89536	5602-169342	1		
	Drum Assembly, polarity	2403-162883	89536	2403-162883	1		
	Drum Assembly, 0-10	2403-162891	89536	2403-162891	3		
	Drum Assembly, 0-100	2403-162909	89536	2403-162909	1		
	Gear, nylon	3155-154682	08863	3155-154682	5		

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Fuseholder	2102-160846	75915	34-2004	1		
	Knob, 5/8" dia.	2405-158949	89536	2405-158949	5		
	Knob, 1" dia, w/bar	2405-158956	89536	2405-158956	3		
	Bail, wire	3153-163386	89536	3153-163386	1		
	Rubber feet	2819-103309	83478	9102-W	4		
	Line cord (not illustrated)	6005-161638	91934	019-1, SVT, 107-1	1		
	Top cover	3156-167619	89536	3156-167619	1		
	Side cover	3156-167635	89536	31536-167635	2		
	Handle	2404-101857	12136	919-415-173	1		
	Bottom cover	3156-167627	89536	3156-167627	1		
	Side cover, front	3156-162164	89536	3156-162164	2		
	Battery cover (873AB only)	3155-162305	89536	3155-162305	2		
BT1	Battery, Ni-Cad 10.5V, 0.5AH	4002-160408	06860	500BH	2		
BT2	Battery, Ni-Cad 10.5V, 0.5AH	4002-160408	06860	500BH	2		

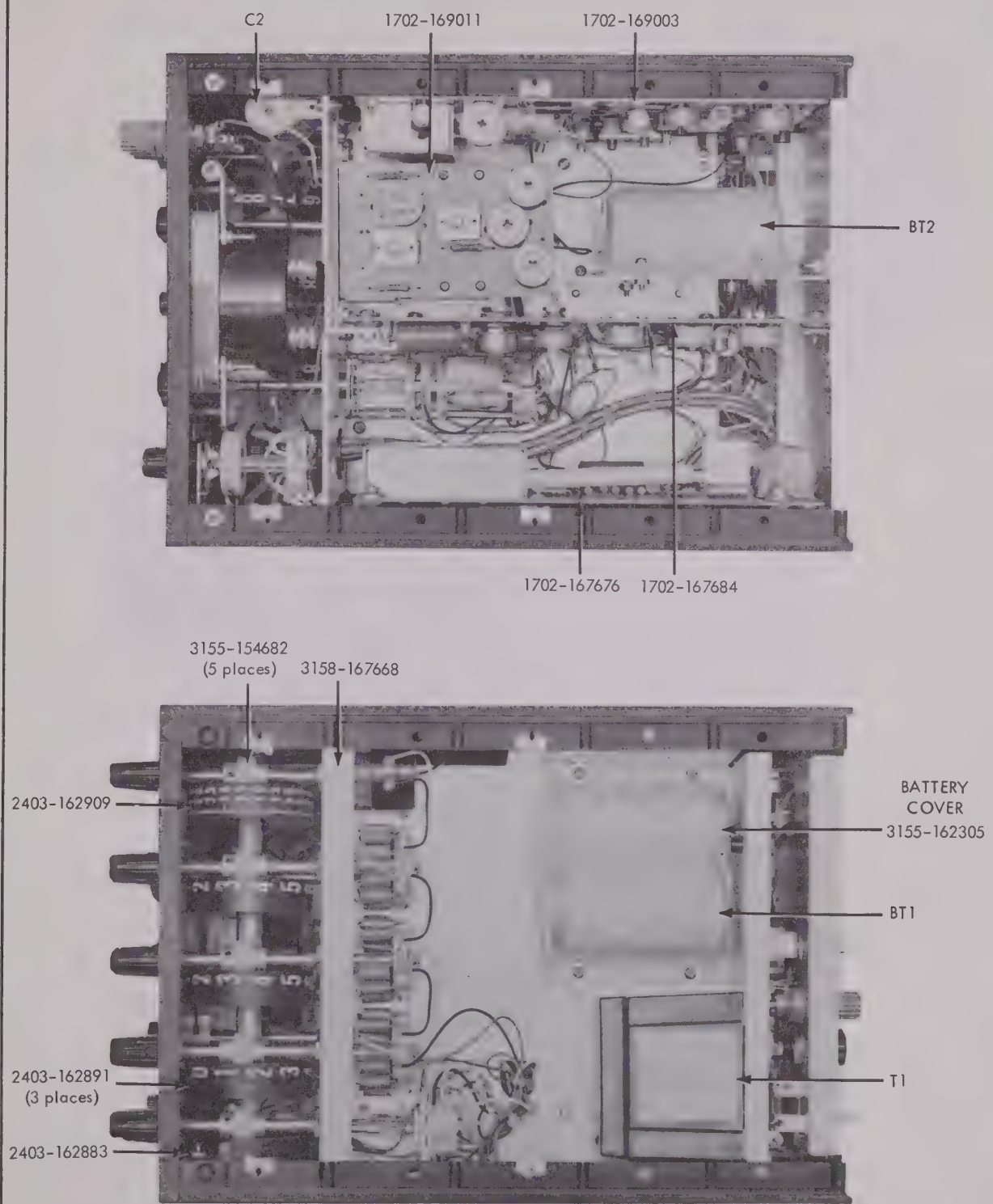


Figure 5-1. FINAL ASSEMBLY (Sheet 1 of 2)

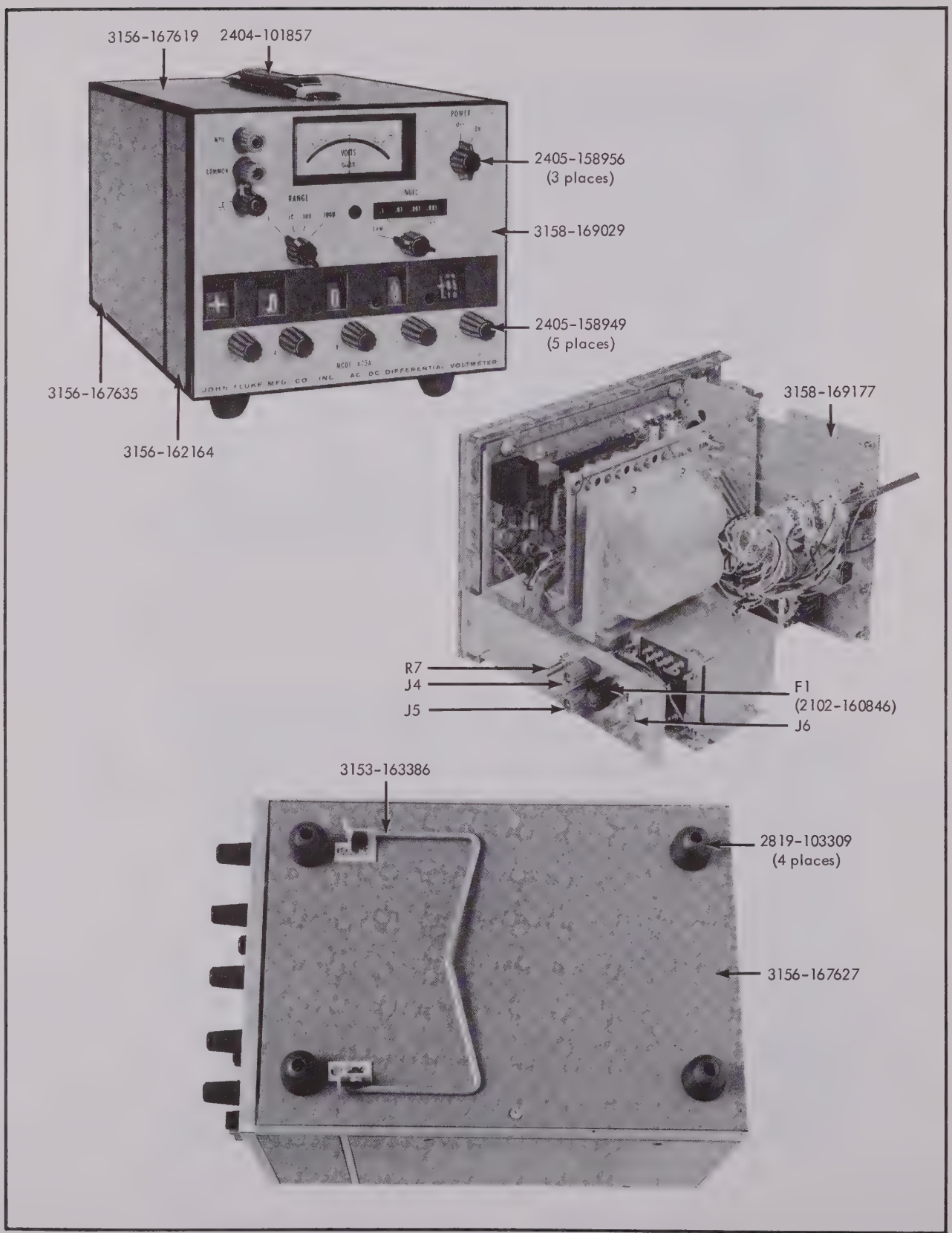


Figure 5-1. FINAL ASSEMBLY (Sheet 2 of 2)

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Front Panel Assembly (873A) (873AB)	3158-169029 3158-169169	89536 89536		1		
C1	Cap, plastic, 0.01 uf ±20%, 1000V	1509-159996	84411	663UW103010W	REF		
C5	Cap, elect, 640 uf -10/+50%, 6.4V (not illustrated)	1502-178608	73445	ARC640	1		
J1, J2	Binding post, red	2811-142976	58474	DF31RC	REF		
J3	Binding post, black	2811-142984	58474	DF31BC	1		
M1	Voltmeter, 100-0-100 ua, 900 ohms (873A only)	2901-159202 2901-201236	89536 38315	2901-159202 Type MS24T	1		
	Voltmeter, 100-0-100 ua, 900 ohms (873AB only)	2901-160382 2901-201244	89536 38315	2901-160382 Type MS24T	1		
R10	Resistor, 270Ω, 1/2W, 10% (not illus.)	4704-108241	01121	RC20	1		

NOTE:
Delete R10 and C5 for voltmeters 2901-159202 and 2901-160382. R10 and C5 are added to provide external damping for voltmeter 2901-201236 and 2901-201244. External damped meters are preferred replacements.

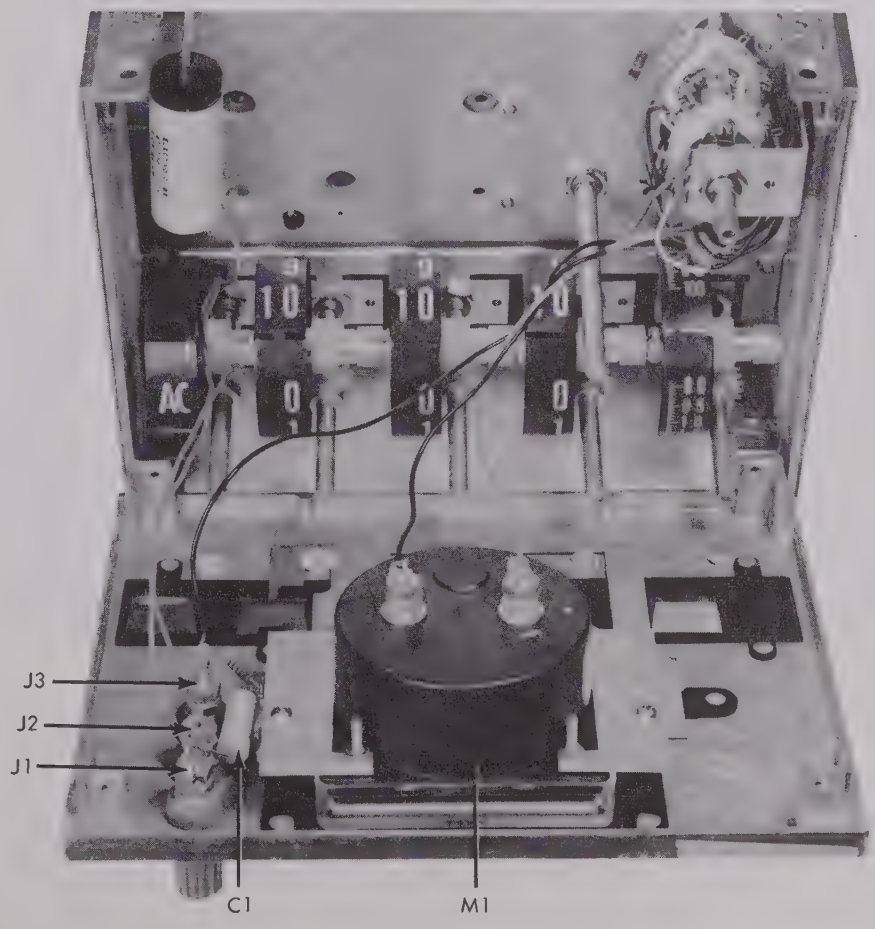


Figure 2. FRONT PANEL ASSEMBLY

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Wiring Assembly				1		
	(873A only)	3158-169037	89536	3158-169037			
	(873AB only)	3158-169177	89536	3158-169177			
C3	Cap, plastic, 1 uf ±20%, 200V (not illustrated)	1507-106450	84411	X663UW10502	1		
R1, R2	Res, met flm, 4.5M ±1%, 1W	4705-159418	14298	CM-1	2		
R3	Res, met flm, 900K ±1%, 1W	4705-159509	19701	Type MF8C-TO	1		
R4	Res, met flm, 90K ±1%, 1/2W	4705-159426	75042	Type CEC-TO	1		
R5	Res, met flm, 9K ±1%, 1/2W	4705-159434	75042	Type CEC-TO	1		
R6	Res, met flm, 1K ±1%, 1/2W	4705-151324	75042	Type CEC-TO	1		
R9	Res, comp, 100K ±5%, 1/2W (873AB only) (not illustrated)	4704-168054	01121	EB1045	1		
S1	Switch, 2 poles, 2 positions (873A only)	5105-162693	89536	5105-162693	1		
	Switch, 8 poles, 5 positions (873AB only)	5105-163360	89536	5105-163360	1		
S2	Switch, 8 poles, 4 positions	5105-162719	89536	5105-162719	1		
S3	Switch, 7 poles, 5 positions	5105-162669	89536	5105-162669	1		
S4	Switch, 8 poles, 3 positions	5105-162701	89536	5105-162701	1		R
	Switch, 8 poles, 3 positions	5105-200782	89536	5105-200782	1		G

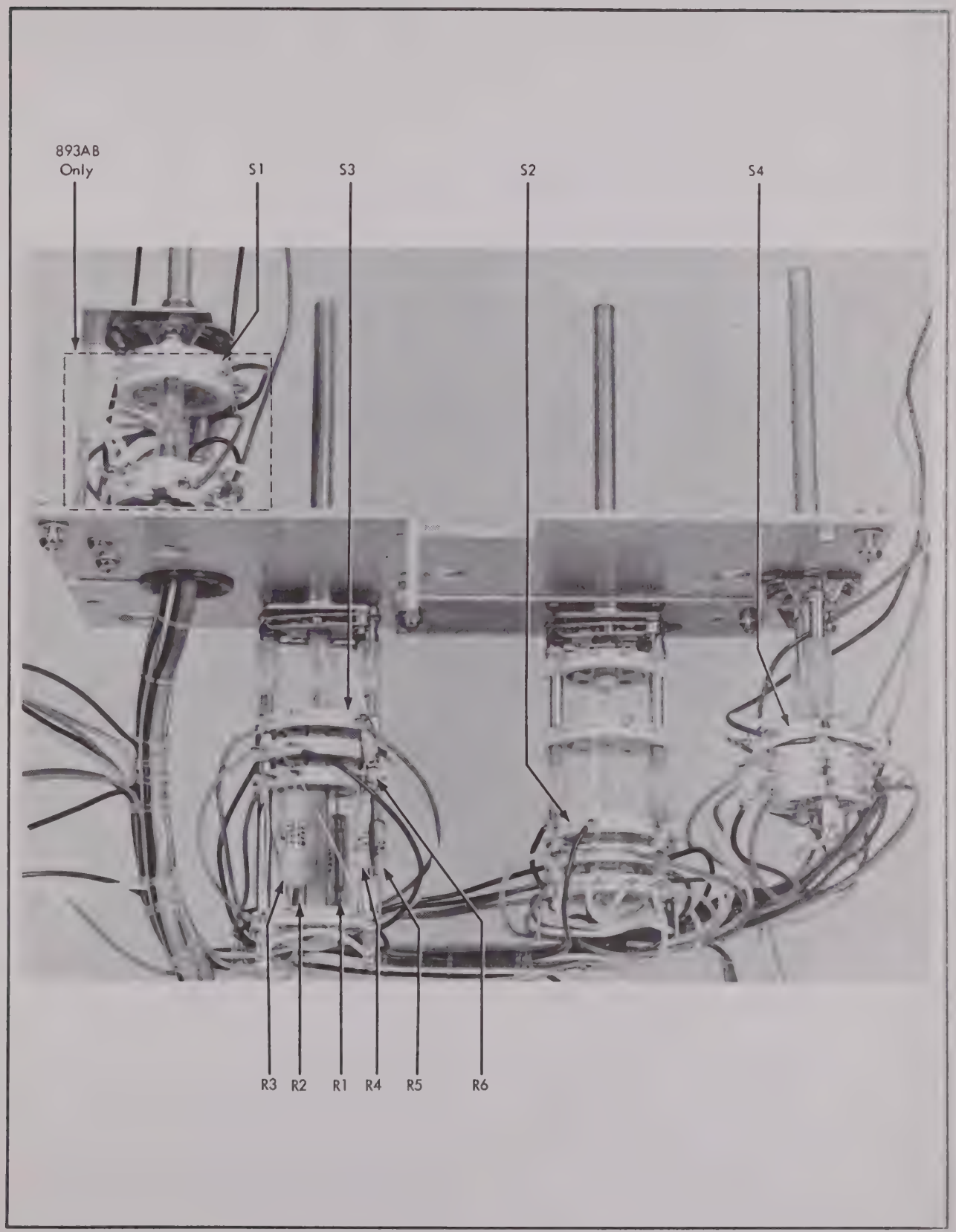


Figure 5-3. WIRING ASSEMBLY

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Reference Supply Assembly	1702-167684	89536	1702-167684	1		
	Zener-Resistor Set	3158-175091	89536	3158-175091	1		
CR103, CR104	Diode, zener, aged, Type 1N3497		89536		2		
R117	Res, WW, 675Ω ±1%, 1/2W		89536		1		
R118	Res, WW, 7.5K to 10K Factory Selected		89536		1		
C101	Cap, Al, elect, 150 uf -10/+150%, 50V	1502-160119	88419	BR150-50	1	1	A
	Cap, Al, elect, 160 uf -10/+50%, 64V	1502-170274	73445	C437ARH160	1	1	B
C102	Cap, Al, elect, 20 uf -10/+75%, 50V	1502-106229	06001	76F02LK200	2	1	A
	Cap, Al, elect, 50 uf -10/+50%, 25V	1502-168823	73445	C426ARF50	2	1	AB
	Cap, Al, elect, 400 uf -10/+50%, 25V	1502-168153	73445	C437ARF400	1	1	~AD
CR101, CR102	Diode, Si, 100 PIV, 1A (CR102 used on 873AB only)	4802-116111	05277	1N4817	4	1	
Q101	Transistor, NPN, Si	4805-153551	07910	CD10449	4	1	~F
	Transistor, NPN, Si	4805-150359	95303	2N3053	2	1	~F
	Transistor, NPN, Si	4805-117135	95303	2N2270	1	1	~N
	Transistor, NPN, Si (If replacement of Q101 is required use 4805-203489, CDQ10656)	4805-203489	07910	CDQ10656	3	1	~E
Q102, Q103	Transistor, NPN, Si	4805-153551	07910	CD10449	REF		A
	Transistor, NPN, Si	4805-168708	33173	2N3391	2	1	B
	Transistor, NPN, Si (If replacement of Q102, Q103 is required, use 4805-203489, CDQ10656)	4805-203489	07910	CDQ10656	REF		~A
Q104	Transistor, PNP, Si	4805-190389	04713	SM4144	3	1	
R101, R102, R103	Res, WW, 3M ±.03%, 1W	4707-165670	89536	4707-165670	3	1	
R104	Res, var, WW, 2K ±20%, 3W	4702-167247	71450	BJ49715	1		
R105	Res, WW, 898.84K ±.03%, 1W	4707-165654	89536	4707-165654	1	1	
R106	Res, var, comp, 250Ω ±30%, 0.3W	4701-166983	71450	Type 70 (without switch)	1		
R107	Res, WW, 99.91K ±.05%, 1/4W	4707-165662	89536	4707-165662	1	1	
R108	Res, comp, 270Ω ±10%, 1/2W	4704-108241	01121	EB2711	1		
R109	Res, met flm, 4.99K ±1%, 1/2W	4705-148890	75042	Type CEC-TO	1		
R110	Res, met flm, 16.2K ±1%, 1/2W	4705-170928	75042	Type CEC-TO	1		
R111	Res, var, WW, 1K ±20%, 1-1/4W	4702-111575	71450	Type 110	1		
R112	Res, comp, 10K ±10%, 1/2W	4704-108118	01121	EB1031	4		

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
R113	Res, comp, 47K ±10%, 1/2W	4704-108480	01121	EB4731	3		
R114	Res, comp, 10K ±10%, 1/2W	4704-108118	01121	EB1031	REF		
R115	Res, comp, 5.6K ±10%, 1/2W	4704-108324	01121	EB5621	4		
R116	Res, comp, 1M ±10%, 1/2W	4704-108134	01121	EB1051	2		F
	Res, comp, 680K ±10%, 1/2W	4704-108340	01121	EB6841	1		O
R119	Res, var, WW, 25Ω ±10%, 1-1/4W	4702-161703	71450	Type 110	1		
R120	Res, WW, 49.45K ±.03%, 1W	4707-167353	89536	4707-167353	1	1	
R121	Res, var, WW, 100Ω ±20%, 1-1/4W	4702-112797	71450	Type 110	2		
R122	Res, WW, 6.111K ±.03%, 1W	4707-163436	89536	4707-163436	1	1	
R123	Res, comp, 120Ω ±10%, 1W	4704-109827	01121	GB1211	1		
R124	Res, comp, 3.9K ±10%, 1/4W (not illustrated)	4704-148064	01121	CB3921	1		P
	Polyethelene grommet	2807-171876	89536	2807-171876	9	2	
	Polyethelene grommet (not illustrated)	2807-171884	89536	2807-171884	1	1	

1 If replacement is required, replace with a new Zener-Resistor Set.

2 This resistor is factory selected for each instrument. When ordering, include all information on old resistor and/or information on Reference Supply Board decal.

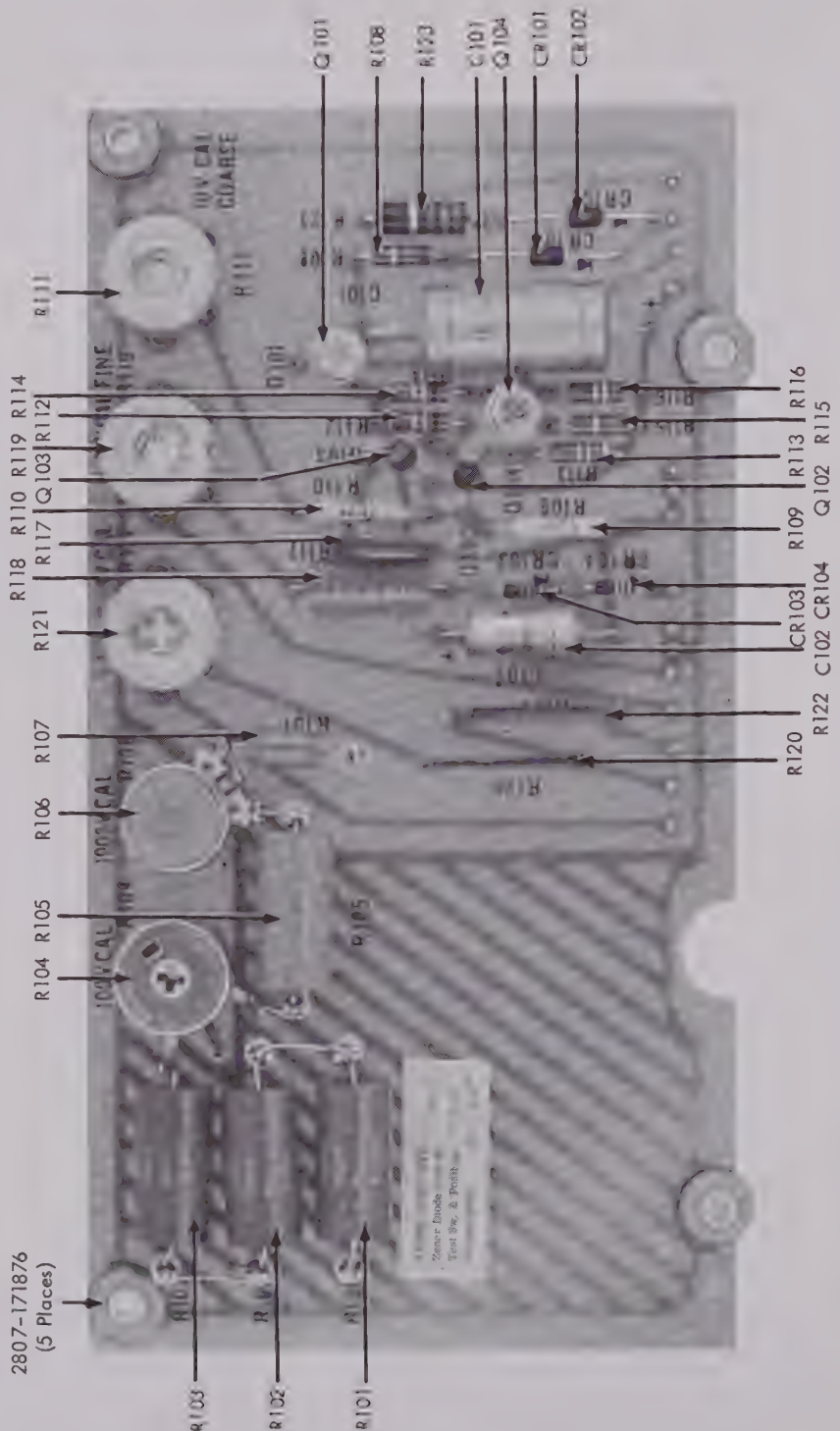


Figure 5-4. REFERENCE SUPPLY ASSEMBLY

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Null Detector Assembly	1702-167676	89536	1702-167676	1		
C201	Cap, plstc, .1 uf ±20%, 120V	1507-167460	99217	Type SEC	1		
C202	Cap, plstc, .22 uf ±20%, 120V	1507-167452	99217	Type SEC	1		
C203	Cap, plstc, .047 uf ±20%, 100V	1507-106096	84411	663UW47301	2		
C204	Cap, Al, elect, 100 uf -10/+75%, 25V	1502-106518	56289	30D107G025DH4	1	1	
C205	Cap, Al, elect, 40 uf -10/+75%, 6V	1502-105205	56289	30D406G006BB4	1	1	H
	Cap, Al, elect, 50 uf -10/+50%, 25V	1502-168823	73445	C426ARF50	1		J
C206	Cap, Al, elect, 5 uf -10/+75%, 25V	1502-152009	56289	30D505G025BA4	3	1	H
	Cap, Al, elect, 10 uf -10/+50%, 25V	1502-170266	73445	C426ARF10	3	1	J
C207	Cap, Al, elect, 1250 uf -10/+50%, 4V	1502-166330	73445	C437ARB1250	2	1	
C208	Cap, Al, elect, 5 uf -10/+75%, 25V	1502-152009	56289	30D505G025BA4	REF		H
	Cap, Al, elect, 10 uf -10/+50%, 25V	1502-170266	73445	C426ARF10	REF		J
C209	Cap, plstc, .0047 uf ±20%, 200V	1507-106054	56289	192P47202	1		
C210	Cap, cer, 500 pf ±10%, 500V	1501-105692	56289	40C210	2		
C211	Cap, plstc, .022 uf ±20%, 100V	1507-106039	84411	663UW22301	1		
C212	Cap, plstc, .047 uf ±20%, 100V	1507-106096	84411	663UW47301	REF		
C213	Cap, Al, elect, 5 uf -10/+75%, 25V	1502-152009	56289	30D505G025BA4	REF		H
	Cap, Al, elect, 10 uf -10/+50%, 25V	1502-170266	73445	C426ARF10	REF		J
C214	Cap, Al, elect, 1250 uf -10/+50%, 4V	1502-166330	73445	C437ARB1250	REF		
C215	Cap, cer, 500 pf ±10%, 500V	1501-105692	56289	40C210	REF		
C216	Cap, cer, .01 uf ±20%, 50V	1501-149153	13606	C023B101F103	1		AG
CR201	Diode, Si, Stabistor, 6 PIV, .15A (not illustrated)	4802-113308	07910	CD13161	1		H
DS201	Lamp, neon (coated with epoxy resin)	3902-162776	89536	3902-162776	1	1	
DS202	Lamp, neon (not illustrated)	3902-162602	89730	NE2U	1	1	
Q201	Transistor, field effect, P-channel, Si	4805-159210	17856	SU443	1	1	
Q202	Transistor, PNP, Si	4805-159491	04713	SM4144	2	1	K
	Transistor, PNP, Si	4805-169375	65092	2N3638	4	1	S
	Transistor, PNP, Si	4805-195974	04713	2N3906	1		T
Q203 thru Q205	Transistor, PNP, Ge	4805-148643	01295	2N1307	3	1	H
	Transistor, PNP, Si	4805-169375	65092	2N3638	3		J
Q206, Q207	Transistor, NPN, Ge	4805-117127	01295	2N1304	2	1	
Q208	Transistor, NPN, Si	4805-150359	95303	2N3053	REF		~N
	Transistor, NPN, Si (If replacement of Q208 is required use 4805-203489, CDQ10656)	4805-203489	07910	CDQ10656	REF		~E

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
Q209	Transistor, PNP, Si	4805-159491	04713	Same as Q202	REF		H
	Transistor, PNP, Ge	4805-148619	01295	2N1303	1	1	U
	Transistor, PNP, Ge	4805-182709	01295	GA2877	1		T
R201	Res, comp, 270K ±10%, 2W	4704-110023	01121	HB2741	1		
R202	Res, comp, 470K ±10%, 1/2W	4704-108290	01121	EB4741	3		
R203	Res, met film, 200Ω ±1%, 1/2W	4705-151480	75042	Type CEC-TO	1		
R204	Res, comp, 1.2M ±10%, 1/2W	4704-108407	01121	EB1251	1		
R205	Res, comp, 2.2M ±10%, 1/2W	4704-108225	01121	EB2251	1		
R206	Res, comp, 22K ±10%, 1/2W	4704-108209	01121	EB2231	2		
R207	Res, comp, 1.8K ±10%, 1/2W (not illustrated)	4704-108860	01121	EB1821	3		
R208	Res, met film, 6.81K ±1%, 1/2W	4705-162552	75042	Type CEC-TO	1		
R209	Res, var, WW, 5K ±5%, 2W	4702-111609	71450	Type 115	1		
R210	Res, comp, 120K ±10%, 1/2W	4704-108779	01121	EB1241	5		
R211	Res, comp, 470K ±10%, 1/2W	4704-108290	01121	EB4741	REF		
R212	Res, comp, 120K ±10%, 1/2W	4704-108779	01121	EB1241	REF		
R213	Res, comp, 47K ±10%, 1/2W	4704-108480	01121	EB4731	REF		
R214	Res, comp, 5.6K ±10%, 1/2W	4704-108324	01121	EB5621	REF		
R215	Res, comp, 1.8K ±10%, 1/2W	4704-108860	01121	EB1821	REF		
R216	Res, comp, 4.7Ω ±10%, 1/2W	4704-165746	01121	EB47G1	1		
R217	Res, comp, 470K ±10%, 1/2W	4704-108290	01121	EB4741	REF		
R218, R219	Res, var, comp, 100K ±20%, 1-1/4W	4701-163873	71450	Type UPE200	3		
R220, R221	Res, comp, 120K ±10%, 1/2W	4704-108779	01121	EB1241	REF		
R222	Res, comp, 1.8K ±10%, 1/2W	4704-108860	01121	EB1821	REF		
R223, R224	Res, comp, 15K ±10%, 1/2W	4704-108530	01121	EB1531	4		
R225	Res, comp, 47K ±10%, 1/2W	4704-108480	01121	EB4731	REF		
R226	Res, comp, 120K ±10%, 1/2W	4704-108779	01121	EB1241	REF		
R227	Res, var, comp, 100K ±20%, 1-1/4W	4701-163873	71450	Type UPE 200	REF		
R228	Res, comp, 47M ±10%, 1/2W	4704-146415	01121	EB4761	1		
R229	Res, comp, 15K ±10%, 1/2W	4704-108530	01121	EB1531	REF		
R230	Res, comp, 3.3K ±10%, 1/2W	4704-108373	01121	EB3321	2		

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
R231	Res, var, WW, 100Ω ±20%, 1-1/4W	4702-112797	71450	Type 110	REF		
R232	Res, met flm, 402Ω ±1%, 1/2W	4705-150839	75042	Type CEC-TO	1		
R233	Res, met flm, 17.8K ±1%, 1/2W	4705-162545	75042	Type CEC-TO	1	V	
	Res, met flm, 18.2K ±1%, 1/2W	4705-217778	75042	4705-217778	1	W	
R234	Res, met flm, 14.7K ±1%, 1/2W	4705-162537	75042	Type CEC-TO	1		
R235	Res, met flm, 15.8K ±1%, 1/2W	4705-171983	75042	Type CEC-TO	1	V	
	Res, met flm, 15.0K ±1%, 1/2W	4705-151498	75042	Type CEC-TO	1	W	
R236, R237	Res, comp, 10K ±10%, 1/2W	4704-108118	01121	EB1031	REF		
R238	Res, comp, 5.6K ±10%, 1/2W	4704-108324	01121	EB5621	REF		L
R239	Res, comp, 10K ±10%, 1/2W	4704-108118	01121	EB1031	REF		X
T201	Transformer	5602-167775	89536	5602-167775	1		
V201	Photoelectric cell	3700-200287	89536	3700-200287	1	1	
	Rod, optical (not illustrated)	3800-168047	89536	3800-168047	1		
	Polyethelene grommet, 3/8 x 1/4	2807-171876	89536	2807-171876	REF		

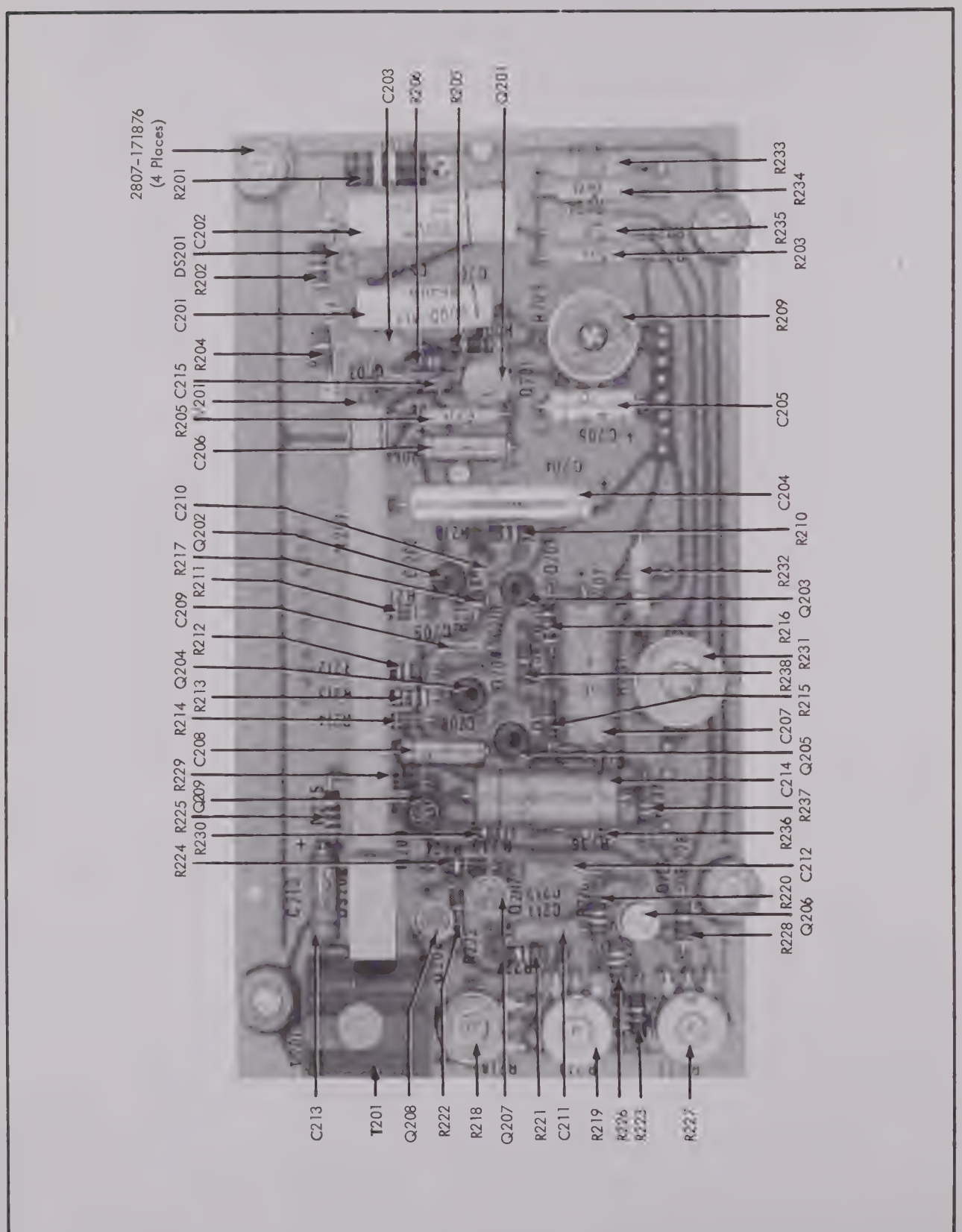


Figure 5-5. NULL DETECTOR ASSEMBLY

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Kelvin-Varley Resistor Assembly	3158-167668	89536	3158-167668			
R301	Res, var, WW, 2.5K ±.5%, Dial "D"	4711-163154	89536	4711-163154	1		
R302	Res, WW, 476.2Ω ±.05%, 1/4W (not illustrated)	4707-163956	89536	4707-163956	1		
R303 thru R313	Res, WW, 200Ω ±.06%, 1/4W	1	89536		11		
R314 thru R324	Res, WW, 1K ±.05%, 1/4W	1	89536		11		
R325 thru R336	Res, WW, 5K ±.05%, 1/4W	1	89536		12		
S301	Switch, rotary, Dial "A", 2 poles, 11 positions	5105-162644	89536	5105-162644	1		
S302, S303	Switch, rotary, Dials "B" & "C", 2 poles, 10 positions	5105-162651	89536	5105-162651	2		
	1 These resistors are factory matched for each instrument. When ordering, include all information stamped on old resistor and/or adjacent resistors.						

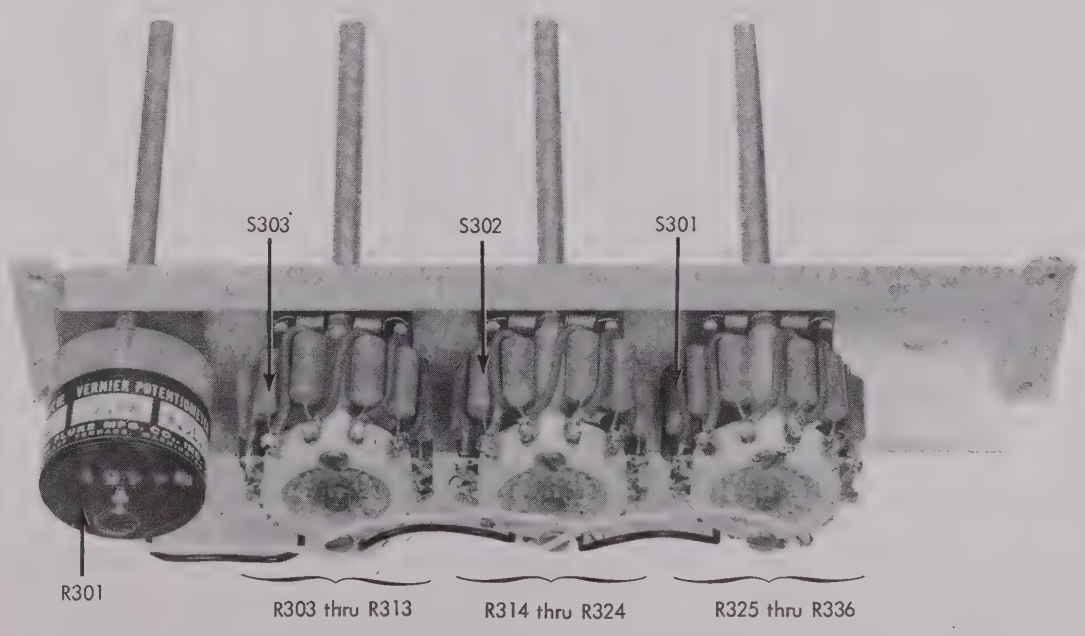


Figure 5-6. KELVIN-VARLEY RESISTOR ASSEMBLY

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Attenuator PCB Assembly	1702-169011	89536	1702-169011	1		
C401	Cap, treated, cer, 3.3 pf ±0.25 pf, 500V (Replace with 1501-178681)	1501-169102	89536	1501-169102	1		~A
	Cap, cer, 3 pf ±0.25 pf, 1100V	1501-178681	00656	Type C1-2	1		~B
C402	Cap, var, cer, 4.5 to 25 pf, 500V	1509-167007	72982	503-001	1		
C403	Cap, cer. treated, 1.8 f ±0.25 pf, 600 VDC (Replace with 1501-178673)	1501-169094	89536	1501-169094	1		~A
	Cap, cer, 1 pf ±0.1 pf, 1100V	1501-178673	00656	Type C1-2	2		~B
C404	Cap, var, trimmer, 9-180 pf, 175V	1509-143347	02799	46-W-463	1		
C405	Cap, var, trimmer, 80 to 480 pf, 175V	1509-168112	02799	46-W-466	1		~H
	Cap, var, trimmer, 170 to 780 pf	1509-106245	02799	46-W-469	1		~J
	Cap. assy, treated	1501-170027	89536	1501-170027	1		~A
C406, C407	Cap, cer, 2.2 pf ±0.25 pf, 500V (C407 not illustrated)				2		
C406	Cap, cer, 1 pf ±.1 pf, 1100V	1501-178673	00656	Type C1-2	REF		~B
C408	Cap, mica, 390 pf ±5 pf, 500V	1504-148437	88419	CD15F391J	1		AE
	Matched Resistor Set	4705-168021	89536	4705-168021	1		
R401	Res, met flm, 900K ±0.25%, 1W	1					
R402	Res, met flm, 110.5K ±0.25%, 1/2W	1					
R403	Res, var, WW, 1.5K ±10%, 1-1/4W	4702-156398	71450	Type 110	1		
	Matched Resistor Set	4705-168005	89536	4705-168005	1		
R404	Res, met flm, 990K ±0.25%, 1W	1					
R405	Res, met flm, 10.04K ±0.25%, 1/2W	1					
R406	Res, var, WW, 150Ω ±20%, 1-1/4W	4702-163642	71450	Type 110	1		
	Matched Resistor Set	4705-168039	89536	4705-168039	1		
R407	Res, met flm, 1M ±0.25%, 2W	1					
R408	Res, met flm, 995Ω ±0.25%, 1/2W	1					
R409	Res, var, WW, 15Ω ±20%, 1-1/4W	4702-163634	71450	Type 110	1		
R410	Res, comp, 180K ±10%, 1/2W	4704-108431	01121	EB1841	1		C

1 If replacement is necessary, replace the matched set, and recalibrate the ac-to-dc converter.

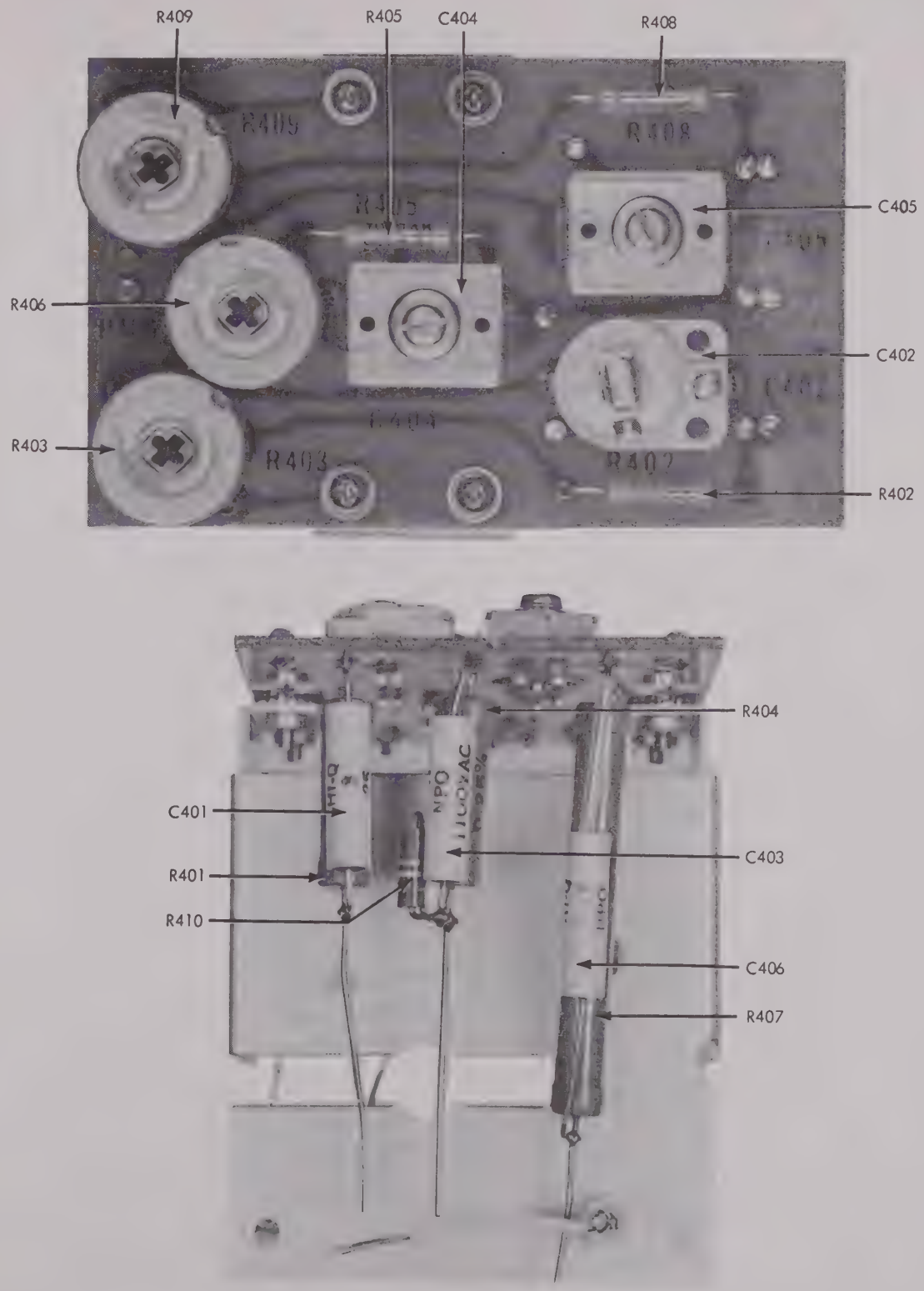


Figure 5-7. ATTENUATOR PCB ASSEMBLY

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
	Converter Assembly	1702-169003	89536	1702-169003	1		
C501	Capacitor treated, cer, 5.0 pf ±10%, 500V (Replace with 1501-187682)	1501-166843	89536	1501-166843	1		∿A
	Capacitor, cer, 5 pf ±.25 pf, 1100 V	1501-187682	00656	Type C1-2	1		∿B
C502	Cap, var, cer, treated 0.8 to 8.5 pf, 1250 VDC (Replace with 1509-188698)	1509-106872	89536	1509-106872	1		∿A
	Cap, var, cer, 1.0 to 10 pf, 400V	1509-188698	91293	JMC 2903	1		∿B
C503	Cap, cer, 15 pf ±10%, 500V	1502-159947	00656	C1-1	1		
C504	Cap, plstc, 5 uf ±20%, 20V	1507-160952	00656	V-146-ZR	1		
C505	Cap, Al, elect, 30 uf -10/+75%, 15V	1502-106492	06001	76F02FE300	2	1	
C506	Cap, Al, elect, 250 uf -10/+75%, 12V	1502-160002	06001	76F02EN251	2	1	
C507	Cap, mica, 33 pf ±5%, 500V	1504-160317	88419	CD15E330J	1		
C508	Cap, Ta, elect, 68 uf ±20%, 6V	1508-160242	05397	K68P6	1	1	
C509	Cap, mica, 22 pf ±5%, 500V	1504-148551	88419	CD15E220J	1		
C510	Cap, Al, elect, 250 uf -10/+75%, 12V	1502-160002	06001	76F02EN251	REF		
C511	Cap, Ta, elect, 10 uf ±10%, 20V	1508-160259	05397	K10C20K	1	1	
C512	Cap, plstc, 1000 pf ±10%, 200V	1507-159582	56289	192P10292	1		
C513	Cap, Ta, elect, 2.2 uf ±10%, 20V	1508-160226	05397	K2R2C20K	2	1	
C514	Cap, Ta, elect, 150 uf ±10%, 6V	1508-160234	05397	K150C6K	1	1	
C515	Cap, plstc, 470 pf ±10%, 200V	1507-159574	56289	192P47192	1		
C516	Cap, Ta, elect, 150 uf -15/+20%, 15V	1508-160945	56289	109D157C2015 TO	1	1	
C517, C518	Cap, plstc, 2 uf ±20%, 10V	1507-160960	00656	V-146-ZR	2		
C519	Cap, Al, elect, 50 uf -10/+75%, 50V	1502-105122	06001	76F02LM500	1	1	
C520	Cap, Ta, elect, 2.2 uf ±10%, 20V	1508-160226	05397	K2R2C20K	REF		
C521	Cap, Al, elect, 30 uf -10/+75%, 15V	1502-106492	06001	76F02FE300	REF		
C522	Cap, Al, elect, 20 uf -10/+75%, 50V	1502-106229	06001	76F02LK200	1		
CR501	Diode, Si, 20 PIV, 0.010A	4802-161810	03877	SG5337	3	1	
CR502	Diode, Si, zener, 6.8V, 0.400W	4803-166199	07910	1N754	2	1	M
	Diode, Si, zener, 6.8V, 0.001A	4803-187195	07910	CD36554	2	1	E
CR503 CR504	Diode, Si, 20 PIV, 0.010A	4802-161810	03877	SG5337	REF		
CR505	Diode, Si, 100 PIV, 1A	4802-116111	05277	1N4817	REF		

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
CR506	Diode, Si, zener, 6.8V, 0.400W	4803-166199	07910	IN754	REF		M
	Diode, Si, zener, 6.8V, 0.001A	4803-187195	07910	CD36554	REF		E
CR507	Diode, Si, 100 PIV, 1A	4802-116111	05277	IN4817	REF		
Q501	Transistor, field-effect, N-channel	4805-166223	15818	U-1249	1	1	
Q502	Transistor, NPN, Si	4805-159855	07910	CS23030	5	1	AF
	Transistor, NPN, Si	4805-218081	04731	MPS6520	1	1	AB
Q503 thru Q506	Transistor, NPN, Si	4805-159855	07910	CS23030	4	2	
Q507	Transistor, PNP, Si	4805-190389	04713	SM4144	REF		
Q508	Transistor, NPN, Si	4805-153551	07910	CD10449	REF		N
	Transistor, NPN, Si (Use 4805-203489 for replacement)	4805-203489	07910	CDQ10656	REF		E
Q509	Transistor, PNP, Si	4805-190389	04713	SM4144	REF		
	Matched Resistor Set	4705-168013	89536	4705-168013	1		
R501	Res, met flm, 1M ±0.25%, 1W (not illustrated)				1		
R502	Res, met flm, 247.6K ±0.25%, 1/2W				1		
R503	Res, var, WW, 5K ±5%, 1-1/4W	4702-163709	71450	Type 110	1		
R504	Res, WW, 125Ω ±0.1%, 1/4W	4707-159764	15909	Type R1136	1		
R505	Res, comp, 1M ±10%, 1/2W	4704-108134	01121	EB1051	REF		
R506	Res, comp, 22K ±10%, 1/2W	4704-108209	01121	EB2231	REF		
R507	Res, var, WW, 10K ±20%, 1-1/4W	4702-112862	71450	Type 110	1		
R508	Res, comp, 10K ±5%, 1/2W	4704-109165	01121	EB1035	5		
R509	Res, comp, 56K ±10%, 1/2W	4704-108472	01121	EB5631	1		AF
	Res, comp, 33K ±10%, 1/2W	4704-178541	01121	EB3331	1		AB
R510	Res, comp, 16K ±5%, 1/2W	4704-159632	01121	EB1635	1		
R511	Res, comp, 10K ±5%, 1/2W	4704-109165	01121	EB1035	REF		
R512	Res, comp, 270Ω ±5%, 1/2W	4704-159616	01121	EB2715	1		
R513	Res, comp, 2.7K ±5%, 1/2W	4704-109074	01121	EB2725	1		
R514	Res, comp, 8.2Ω ±5%, 1/2W	4704-159590	01121	EB82G5	1		
R515	Res, comp, 68K ±5%, 1/2W	4704-159624	01121	EB6835	1		
R516	Res, comp, 27K ±10%, 1/2W	4704-108878	01121	EB2731	1		
R517	Res, comp, 3.3K ±10%, 1/2W	4704-108373	01121	EB3321	REF		
R518	Res, comp, 15K ±10%, 1/2W	4704-108530	01121	EB1531	REF		
R519	Res, comp, 470Ω ±5%, 1/2W	4704-108787	01121	EB4715	2		

REF DESIG.	DESCRIPTION	FLUKE STOCK NO.	MFR.	MFR. PART NO.	TOT. QTY.	REC. QTY.	USE CODE
R520	Res, comp, 62K ±5%, 1/2W	4704-108522	01121	EB6235	1		
R521	Res, var, comp, 100K ±30%, 1/2W	4701-160010	71450	Type UPE70	1		
R522	Res, comp, 300Ω ±5%, 1/2W	4704-108829	01121	EB3015	1		
R523	Res, comp, 47Ω ±5%, 1/2W	4704-159608	01121	EB4705	1		
R524	Res, comp, 470Ω ±5%, 1/2W	4704-108787	01121	EB4715	REF		
R525	Res, comp, 330Ω ±10%, 1/2W	4704-108589	01121	EB3311	2		Y
	Res, comp, 150Ω ±10%, 1/2W	4704-186056	01121	EB1511	1		Z
R526	Res, comp, 10K ±5%, 1/2W	4704-109165	01121	EB1035	REF		
R527	Res, comp, 100K ±10%, 1/2W	4704-108126	01121	EB1041	1		
R528	Res, comp, 5.6K ±10%, 1/2W	4704-108324	01121	EB5621	REF		A
	Res, comp, 2.7K ±10%, 1/2W	4704-108837	01121	EB2721	1		B
R529	Res, comp, 22M ±10%, 1/2W	4704-108233	01121	EB2261	1		
R530, R531	Res, WW, 547Ω ±0.1%, 1/4W	4707-159772	15909	Type R1136	2		
R532, R533	Res, met flm, 51.1K ±1%, 1/2W	4705-159665	75042	Type CEC-TO	2		
R534	Res, comp, 330Ω ±10%, 1/2W	4704-108589	01121	EB3311	REF		
R535	Res, comp, 1K ±10%, 1/2W	4704-108563	01121	EB1021	2		
R536	Res, comp, 1.5M ±10%, 1/2W	4704-108175	01121	EB1551	1		
R537	Res, comp, 10K ±5%, 1/2W	4704-109165	01121	EB1035	REF		
R538	Res, met flm, 10K ±1%, 1/2W	4705-151274	75042	Type CEC-TO	1		
R539	Res, var, WW, 3K ±20%, 2W	4702-153429	71450	Type 115	1		
R540	Res, met flm, 5.11K ±1%, 1/2W	4705-159657	75042	Type CEC-TO	1		
R541	Res, comp, 1.1Ω ±5%, 1/2W	4704-163717	01121	EB11G5	1		
R542	Res, comp, 10K ±5%, 1/2W	4704-109165	01121	EB1035	REF		
R543	Res, comp, 24K ±5%, 1/2W	4704-108654	01121	EB2435	1		
R544	Res, comp, 130Ω ±5%, 1W	4704-163055	01121	GB1315	1		
R545	Res, comp, 1K ±10%, 1/2W	4704-108563	01121	EB1021	REF		

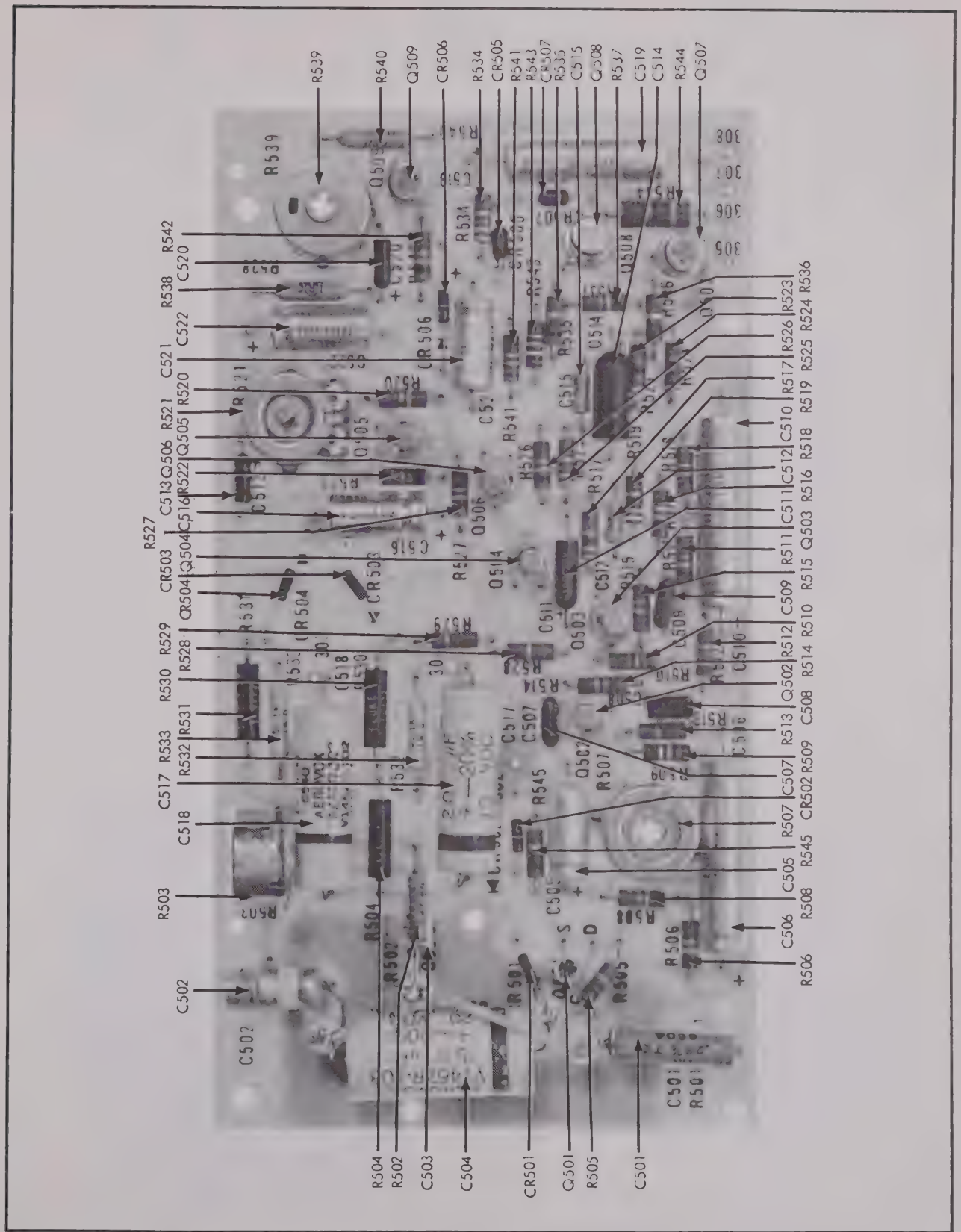


Figure 5-8. CONVERTER ASSEMBLY

5-8. USE CODE EFFECTIVITY

5-9. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the 873A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123. New codes will be added as required by instrument changes.

USE CODE	EFFECTIVITY
No Code	Model 873A and 873AB serial number 123 and on
A	Model 873A and 873AB serial number 123 thru 197
B	Model 873A and 873AB serial number 198 and on
C	Model 873A and 873AB serial number 300 and on
D	Model 873A and 873AB serial number 256, 282, 291 thru 294, 296, 298, 299, 301, 302, 305, 307 and on
E	Model 873A and 873AB serial number 308 and on
F	Model 873A and 873AB serial number 123 thru 134
G	Model 873A and 873AB serial number 468 and on
H	Model 873A and 873AB serial number 123 thru 159
J	Model 873A and 873AB serial number 160 and on
K	Model 873A and 873AB serial number 123 thru 195
L	Model 873A and 873AB serial number 196 and on
M	Model 873A and 873AB serial number 123 thru 307
N	Model 873A and 873AB serial number 123 thru 307
O	Model 873A and 873AB serial number 135 thru 344, 368 thru 399
P	Model 873A and 873AB serial number 345 thru 367, 400 and on
R	Model 873A and 873AB serial number 123 thru 467
S	Model 873A and 873AB serial number 196 thru 529
T	Model 873A and 873AB serial number 530 and on
U	Model 873A and 873AB serial number 160 thru 529
V	Model 873A serial number 123 thru 656 Model 873AB serial number 123 thru 552
W	Model 873A serial number 657 and on Model 873AB serial number 553 and on
X	Model 873A and 873AB serial number 1133 and on
Y	Model 873A and 873AB serial number 123 to 1131
Z	Model 873A and 873AB serial number 1132 and on
AA	Model 873A and 873AB serial number 308 to 1052
AB	Model 873A and 873AB serial number 1053 and on
AC	Model 873A and 873AB serial number 198 to 802
AD	Model 873A and 873AB serial number 803 and on
AE	Model 873A and 873AB serial number 524, 529, 530, 538, 542, 544, 545, 548 and on
AF	Model 873A and 873AB serial number 123 to 1052
AG	Model 873A and 873AB serial number 1338 and on

SECTION VI

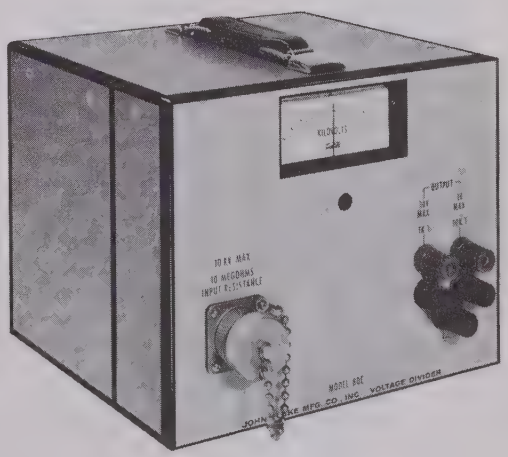
ACCESSORIES

6-1. PRECISION VOLTAGE DIVIDERS

6-2. The FLUKE 80A, 80D, and 80E Voltage Dividers provide the FLUKE 800 Series Differential Voltmeters with the ability to make high accuracy measurements up to 30,000 volts DC. All models contain a zero center panel meter which allows the polarity and approximate magnitude of the unknown high voltage to be easily observed. At maximum input, all units draw but 1 ma of current from the unknown. The extreme accuracy and excellent long term stability of these dividers are obtained by using properly aged precision wirewound resistors which have a very low temperature coefficient. To further ensure high accuracy and long term stability at very high voltages, the 80D dividers have all resistance components immersed in oil within a hermetically sealed container. As an additional feature, all 80D and 80E models are provided with a 1 volt tap which allows measurements of high voltages with a laboratory potentiometer. Specifications for the standard models are shown on next page. Other intermediate models are available upon special request.

MODEL 80A

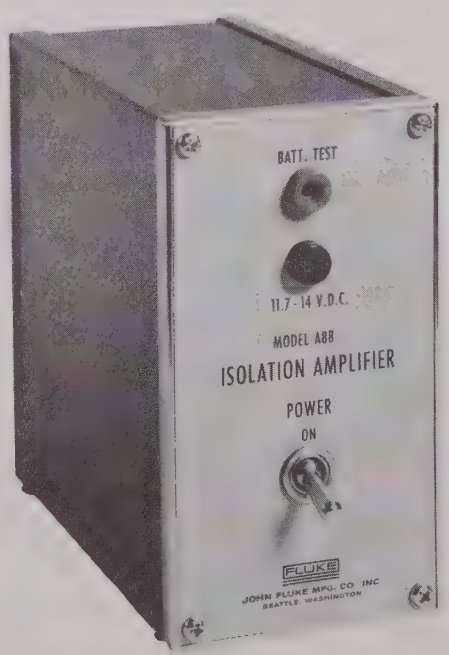
MODEL 80D



MODEL 80E

Model No.	Maximum Input Voltage	Total Resistance	Current Drawn At Max. Input	Division Ratio			Division Ratio Accuracy	Stability of Division Accuracy Per Year
				500V Out	10V Out	1V Out		
80A-1	1 KV	1 M	1 ma	2:1	——	——	±0.015%	——
80A-2	2 KV	2 M	1 ma	4:1	——	——	±0.015%	——
80E-5	5 KV	5 M	1 ma	—	500:1	5,000:1	±0.01%	±0.01%
80E-10	10 KV	10 M	1 ma	—	1000:1	10,000:1	±0.01%	±0.01%
80D-30	30 KV	30 M	1 ma	60:1	3000:1	30,000:1	±0.01%	±0.01%

MODELS	SIZE	INPUT CONNECTOR	OUTPUT CONNECTOR
80A	6-3/4" high 5-1/4" wide 2-1/4" deep	UG-560U with mating connector supplied	Insulated binding posts on 3/4" centers
80E	7" high 8-1/2" wide 8" deep	MS3102A-18-165 with mating connector supplied	Insulated binding posts on 3/4" centers for both outputs
80D	13" high 9-3/4" wide 16" deep	Special 5" ceramic standoff with mating 6" guard supplied	Insulated binding post on 3/4" centers for both outputs



MODEL A88 ISOLATION AMPLIFIER

6-3. ISOLATION AMPLIFIER

6-4. The FLUKE Model A88 all solid-state isolation amplifier is designed to provide isolation between the output of a differential voltmeter and the input of a recorder. Thus, the A88 will allow the use of a wide range of strip chart recorders for recording the voltmeter reading without regard to the input isolation characteristics of the recorder. The A88 is also excellent for making accurate dc microvolt and nanoampere measurements in the presents of common mode voltages up to 1100 vdc and 3 vac, 50 to 500 cycles.

GAIN: 1 volt output per microampere input.

GAIN ACCURACY: ±2%.

INPUT CURRENT RANGE: 0 to 2 microamperes.

INPUT VOLTAGE RANGE: 0 to 2 millivolts nominal.

INPUT RESISTANCE: 950 ohms (±5%).

OUTPUT VOLTAGE RANGE: 0 to 2 volts open circuit.

OUTPUT RESISTANCE: 1000 ohms (±5%).

INPUT ISOLATION FROM CHASSES: Greater than 5×10^{11} ohms at 25°C (77°F), 60% RH and 1×10^{10} ohms at 50°C (122°F), 80% RH.

APPENDIX A

FEDERAL SUPPLY CODE FOR MANUFACTURERS

A-1. CODE TO NAME

A-2. The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213	Sage Electronics Corp. Rochester, New York
00327	Welwyn International, Inc. Westlake, Ohio
00656	Aerovox Corp. New Bedford, Massachusetts
00779	AMP Inc. Harrisberg, Pennsylvania
01121	Allen-Bradley Co. Milwaukee, Wisconsin
01281	TRW Semiconductors Lawndale, California
01295	Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas
01686	RCL Electronics Inc. Manchester, New Hampshire
01730	Deleted
01884	Dearborn Electronics Inc. Orlando, Florida
02114	Ferroxcube Corp. Saugerties, New York
02606	Replaced by 15801
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02799	Arco Capacitors, Inc. Los Angeles, California
03614	Replaced by 71400
03651	Replaced by 44655
03797	Eldema Corp. Compton, California
03877	Transitron Electronic Corp. Wakefield, Massachusetts
03888	Pyrofilm Resistor Co., Inc. Cedar Knolls, New Jersey
03911	Clairex Corp. New York, New York
03980	Muirhead Instruments, Inc. Mountainside, New Jersey
04009	Arrow Hart and Hegemen Electronic Company Hartford, Connecticut
04062	Replaced by 72136
04202	Replaced by 81312
04217	Essex Wire Corp Wire & Cable Div. Anaheim, California
04221	Aemco Div. of Midtex Inc. Mankato, Minnesota
04645	Replaced by 75376
04713	Motorola Semiconductor Products Inc. Phoenix, Arizona
05082	Replaced by 94154
05236	Jonathan Mfg. Co. Fullerton, California
05277	Westinghouse Electric Corp. Semiconductor Dept. Youngwood, Pennsylvania
05278	Replaced by 43543
05397	Union Carbide Corp. Electronics Div. Cleveland, Ohio
05571	Sprague Electric Co Pacific Div. Los Angeles, California
05704	Alac, Inc. Glendale, California
05820	Wakefield Engineering Ind. Wakefield, Massachusetts
06001	General Electric Company Capacitor Department Irmo, South Carolina
06136	Replaced by 63743
06473	Amphenol Space & Missile Sys. Chatsworth, California
06555	Beede Electrical Instrument Co. Penacook, New Hampshire
06739	Electron Corp. Littletown, Colorado
06743	Clevite Corp. Cleveland, Ohio
06751	Semcor Div. Components Phoenix, Arizona
06860	Gould National Batteries Inc. City of Industry, California
06980	Eitel-McCullough, Inc. San Carlos, California
07115	Replaced by 14674
07138	Westinghouse Electric Corp Electronic Tube Div. Elmira, New York
07263	Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California
07344	Bircher Co., Inc. Rochester, New York
07792	Lerma Engineering Corp Northampton, Massachusetts
07910	Continental Device Corp. Hawthorne, California
08530	Reliance Mica Corp. Brooklyn, New York
08792	CBS Electronics Semiconductor Operations-Div. of CBS Inc. Lowell, Massachusetts
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
08863	Nylomatic Corp. Norrisville, Pennsylvania
08988	Skottie Electronics Inc. Archbald, Pennsylvania
09922	Burndy Corp. Norwalk, Connecticut
11237	Chicago Telephone of Calif. Inc. South Pasadena, California
11358	CBS Electronics Div. of CBS Inc. Newburyport, Massachusetts
11403	Best Products Co. Chicago, Illinois
11503	Keystone Mfg Div. of Avis Industrial Corp. Warren, Michigan
12014	Chicago Rivet & Machine Co. Bellwood, Illinois
12040	National Semiconductor Corp. Danburry, Connecticut
12060	Diodes, Inc. Chatsworth, California
12136	Philadelphia Handle Co. Camden, New Jersey
12323	Presin Co., Inc. Shelton, Connecticut
12327	Freeway Washer & Stamping Co. Cleveland, Ohio
12400	Replaced by 75042
12617	Hamlin Inc. Lake Mills, Wisconsin
12697	Clarostat Mfg. Co. Dover, New Hampshire
12749	James Electronics Chicago, Illinois

12856	Micrometals Sierra Madre, California
12954	Dickson Electronics Corp. Scottsdale, Arizona
13606	Sprague Electric Co. Transistor Div. Concord, New Hampshire
13839	Replaced by 23732
14099	Semtech Corp. Newbury Park, California
14193	California Resistor Corp. Santa Monica, California
14298	American Components, Inc. Conshohocken, Pennsylvania
14655	Cornell-Dubilier Electronics Newark, New Jersey
14674	Corning Glass Works Corning, New York
14752	Electro Cube Inc. San Gabriel, California
14869	Replaced by 96853
15636	Elec-Trol Inc. Northridge, California
15801	Fenwal Electronics Inc. Framingham, Massachusetts
15818	Amelco Semiconductor Div. of Teledyne Inc. Mountain View, California
15849	Useco, Inc. Mt. Vernon, New York
15909	Replaced by 17870
16332	Replaced by 28478
16473	Cambridge Scientific Ind. Inc. Cambridge, Maryland
16742	Paramount Plastics Downey, California
16758	Delco Radio Div. of General Motors Kokomo, Indiana
17069	Circuit Structures Lab. Upland, California
17856	Siliconix, Inc. Sunnyvale, California
17870	Daven-Div. of Thomas A. Edison Ind. --McGraw-Edison Co. Manchester, New Hampshire
18083	Deleted
18178	Vactec Inc. Maryland Heights, Missouri
18736	Voltronics Corp. Hanover, New Jersey
19429	Montronics, Inc. Seattle, Washington
19451	Perine Machinery & Supply Co. Seattle, Washington
19701	Electra Mfg. Co. Independence, Kansas
20584	Enochs Mfg. Co. Indianapolis, Indiana
22767	ITT Semiconductors Div. of ITT Palo Alto, California
23732	Tracor Rockville, Maryland
24248	Southco Div. of South Chester Corp. Lester, Pennsylvania
24655	General Radio Co. West Concord, Massachusetts
25403	Amperex Electronic Corp Semiconductor & Receiving Tube Division Slatersville, Rhode Island
28478	Deltrol Controls Corp. Milwaukee, Wisconsin
28520	Heyman Mfg. Co. Kenilworth, New Jersey
30323	Illinois Tool Works Inc. Chicago, Illinois
33173	General Electric Co. Tube Dept. Owensboro, Kentucky
37942	Mallory, P. R., & Co., Inc. Indianapolis, Indiana
38315	Honeywell Inc. Precision Meter Div. Manchester, New Hampshire
42498	National Company Melrose, Massachusetts
43543	Nytronics Inc. Transformer Co. Div. Alpha, New Jersey
44655	Ohmite Mfg. Co. Skokie, Illinois
49671	Radio Corp. of America New York, New York
49956	Raytheon Company Lexington, Maine
53021	Sangamo Electric Co. Springfield, Illinois
55026	Simpson Electric Company Chicago, Illinois
56289	Sprague Electric Co. North Adams, Massachusetts
58474	Superior Electric Co. Bristol, Connecticut
60399	Torrington Mfg. Co. Torrington, Connecticut
62460	Deleted
63743	Ward Leonard Electric Co. Mount Vernon, New York
64834	West Mfg. Co. San Francisco, California
65092	Weston Instruments Inc. Newark, New Jersey
66150	Winslow Tele-Tronics Inc. Asbury Park, New Jersey
70563	Amperite Company Union City, New Jersey
70903	Belden Mfg. Co. Chicago, Illinois
71002	Birnbach Radio Co., Inc. New York, New York
71400	Bussmann Mfg. Div. of McGraw-Edison Co. St. Louis, Missouri
71450	CTS Corp. Elkhart, Indiana
71468	ITT Cannon Electric Inc. Los Angeles, California
71482	Clare, C. P. & Co. Chicago, Illinois
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wisconsin
71707	Coto Coil Co., Inc. Providence, Rhode Island
71744	Chicago Miniature Lamp Works Chicago, Illinois
71785	Cinch Mfg. Co. & Howard B. Jones Div. Chicago, Illinois
72005	Driver, Wilber B., Co. Newark, New Jersey
72092	Replaced by 06980
72136	Electro Motive Mfg. Co. Willimantic, Connecticut
72259	Nytronics Inc. Berkeley Heights, New Jersey
72354	Deleted
72619	Dialight Corp. Brooklyn, New York
72653	G. C. Electronics Rockford, Illinois
72665	Replaced by 90303
72794	Dzus Fastener Co., Inc. West Islip, New York
72928	Gudeman Co. Chicago, Illinois
72982	Erie Tech. Products Inc. Erie, Pennsylvania
73138	Beckman Instruments Inc. Helipot Division Fullerton, California
73293	Hughes Aircraft Co. Electron Dynamics Div. Newport Beach, California
73445	Amperex Electronic Corp. Hicksville, New York
73559	Carling Electric Inc. Hartford, Connecticut
73586	Circle F Industries Trenton, New Jersey
73734	Federal Screw Products, Inc. Chicago, Illinois
73743	Fischer Special Mfg. Co. Cincinnati, Ohio
73899	JFD Electronics Co. Brooklyn, New York
73949	Guardian Electric Mfg. Co. Chicago, Illinois
74199	Quam Nichols Co. Chicago, Illinois
74217	Radio Switch Corp. Marlboro, New Jersey
74276	Signalite Inc. Neptune, New Jersey
74306	Piezo Crystal Co. Carlisle, Pennsylvania
74542	Hoyt Elect. Instr. Works Penacook, New Hampshire
74970	Johnson, E. F., Co. Waseca, Minnesota
75042	IRC Inc. Philadelphia, Pennsylvania
75376	Kurz-Kasch, Inc. Dayton, Ohio
75382	Kulka Electric Corp. Mt. Vernon, New York
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
77342	Potter & Brumfield Div. of Amer. Machine & Foundry Princeton, Indiana
77969	Rubbercraft Corp. of Calif. LTD. Torrance, California

78189	Shakeproof Div. of Illinois Tool Works Elgin, Illinois
78277	Sigma Instruments, Inc. South Braintree, Massachusetts
78488	Stackpole Carbon Co. St. Marys, Pennsylvania
78553	Tinnerman Products Cleveland, Ohio
79136	Waldes Kohinoor Inc. Long Island City, New York
79497	Western Rubber Company Goshen, Indiana
79963	Zierick Mfg. Corp. New Rochelle, New York
80031	Mepco Div. of Sessions Clock Co. Morristown, New Jersey
80145	API Instruments Co. Chesterland, Ohio
80183	Sprague Products North Adams, Massachusetts
80294	Bourns Inc. Riverside, California
80583	Hammarlund Co., Inc. Mars Hill, North Carolina
80640	Stevens, Arnold Inc. Boston, Massachusetts
81073	Grayhill Inc. La Grange, Illinois
81312	Winchester Electronics Div. of Litton Industries Oakville, Connecticut
81439	Therm-O-Disc Inc. Mansfield, Ohio
81483	International Rectifier Corp. El Segundo, California
81590	Korry Mfg. Co. Seattle, Washington
82376	Deleted
82389	Switchcraft Inc. Chicago, Illinois
82415	Price Electric Corp. Frederick, Maryland
82872	Roanwell Corp. New York, New York
82877	Rotron Mfg. Co., Inc. Woodstock, New York
82879	ITT Wire & Cable Div. Pawtucket, Rhode Island
83003	Varo Inc. Garland, Texas
83298	Bendix Corp. Electric Power Division Eatontown, New Jersey
83330	Smith, Herman H., Inc. Brooklyn, New York
83478	Rubbercraft Corp. of America New Haven, Connecticut
83594	Burroughs Corp. Electronic Components Div. Plainfield, New Jersey
83740	Union Carbide Corp. Consumer Products Div. New York, New York
84171	Arco Electronics, Inc. Great Neck, New York
84411	TRW Ogallala, Nebraska
86577	Precision Metal Products Stoneham, Massachusetts
86684	Radio Corp. of America Electronic Components & Devices Harrison, New Jersey
86689	Deleted
87034	Marco-Oak Inc. Anaheim, California
88419	Use 14655
88690	Replaced by 04217
89536	Fluke, John Mfg. Co., Inc. Seattle, Washington
89730	Replaced by 08806
90201	Mallory Capacitor Co. Indianapolis, Indiana
90215	Best Stamp & Mfg. Co. Kansas City, Missouri
90211	Square D Co. Chicago, Illinois
90303	Mallory Battery Co. Tarrytown, New York
91293	Johanson Mfg. Co. Boonton, New Jersey
91407	Replaced by 58474
91637	Dale Electronics Inc. Columbus, Nebraska
91662	Elco Corp. Willow Grove, Pennsylvania
91737	Gremar Mfg. Co., Inc. Wakefield, Massachusetts
91802	Industrial Devices, Inc. Edgewater, New Jersey
91836	King's Electronics Tuckahoe, New York
91929	Honeywell Inc. Micro Switch Div. Freeport, Illinois
91934	Miller Electric Co., Inc. Pawtucket, Rhode Island
93332	Sylvania Electric Products Semiconductor Products Div. Woburn, Massachusetts
94145	Replaced by 49956
94154	Tung-Sol Div. of Wagner Electric Corp. Newark, New Jersey
95146	Alco Electronics Products Inc. Lawrence, Massachusetts
95263	Leecraft Mfg. Co. Long Island City, New York
95264	Replaced by 98278
95275	Vitramon Inc. Bridgeport, Connecticut
95303	Radio Corp. of America Solid State & Receiving Tube Div. Cincinnati, Ohio
95354	Methode Mfg. Corp. Rolling Meadows, Illinois
95712	Dage Electric Co., Inc. Franklin, Indiana
95987	Weckesser Co., Inc. Chicago, Illinois
96733	San Fernando Electric Mfg. Co. San Fernando, California
96853	Rustrak Instrument Co. Manchester, New Hampshire
96881	Thomson Industries, Inc. Manhasset, New York
97540	Master Mobile Mounts Div. of Whitehall Electronics Corp. Los Angeles, California
97913	Industrial Electronic Hdware Corp. New York, New York
97945	White, S. S. Co. Plastics Div. New York, New York
97966	Replaced by 11358
98094	Replaced by 49956
98278	Microdot Inc. Pasadena, California
98291	Sealectro Corp. Conhex Div Mamaroneck, New York
98388	Accurate Rubber & Plastics Culver City, California
98743	Replaced by 12749
98925	Deleted
99120	Plastic Capacitors, Inc. Chicago, Illinois
99217	Southern Electronics Corp. Burbank, California
99515	Marshall Industries Capacitor Div. Monrovia, California

Revised August 1, 1968
Using H4-1 and H4-2
Dated June , 1968

WARRANTY

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken.

1. Notify the John Fluke Mfg. Co., Inc., giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc. will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to:

JOHN FLUKE MFG. CO., INC., P. O. BOX 7428, SEATTLE 33, WASHINGTON

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5950 Sixth Ave. South
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800 Linden Avenue
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23203 Lorain Road
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3118 Germantown Pike
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FLUKE

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Arizona Standards Laboratory
4430 N. 19th Ave
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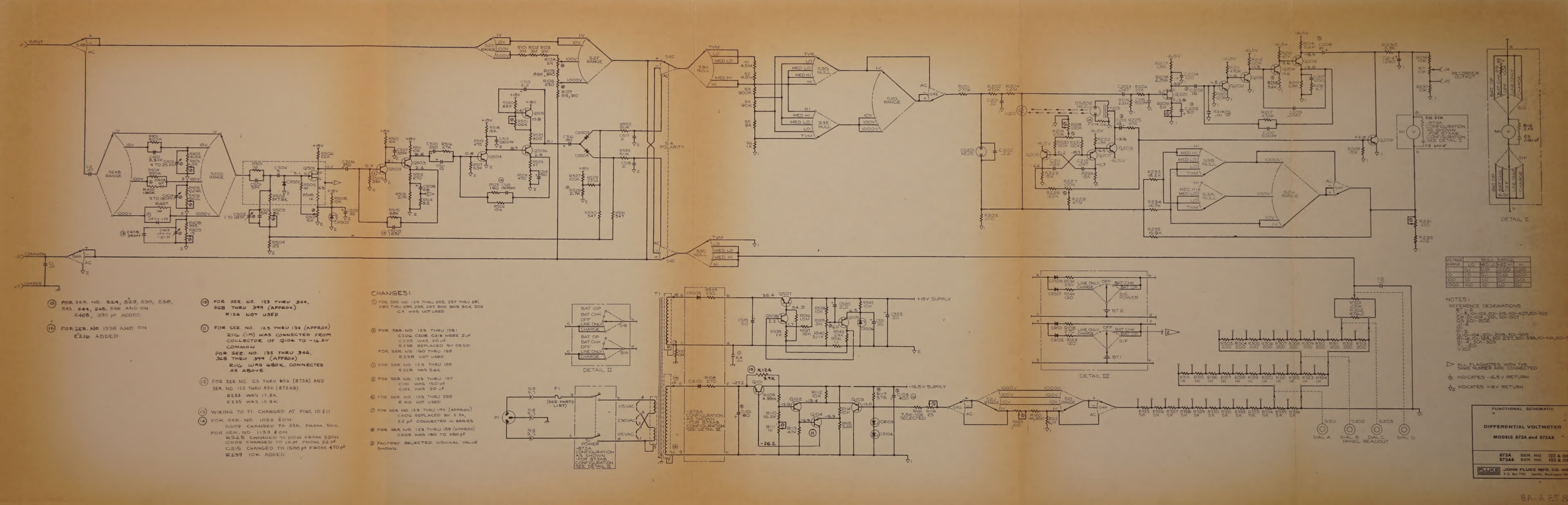
For information regarding service centers in other foreign locations, contact the nearest Sales and Service Representative in your area.



(9) FOR SER. NO. 524, 529, 530, 538, 542, 544, 545, 546 AND ON C408, 390 pf ADDED

(10) FOR SER. NO. 123 THRU 344, 368 THRU 399 (APPROX.) R124 NOT USED

(11) FOR SER. NO. 123 THRU 134 (APPROX) R116 (1M) WAS CONNECTED FROM COLLECTOR OF Q104 TO -16.5V COMMON
FOR SER. NO. 135 THRU 344, 368 THRU 399 (APPROX) R116 WAS 680K, CONNECTED AS ABOVE

(12) FOR SER NO. 123 THRU 656 (873A) AND SER. NO. 123 THRU 552 (873AB)
R233 WAS 17.8K
R235 WAS 15.8K

(13) WIRING TO T1 CHANGED AT PINS 10 & 11

(14) FOR SER. NO. 1053 & ON
RS09 CHANGED TO 35K FROM 56K
FOR SER. NO. 1139 & ON
R525 CHANGED TO 150K FROM 330K
C519 CHANGED TO 10 pf FROM 22 pf.
C515 CHANGED TO 1500 pf FROM 470 pf
R239 10K ADDED

CHANGES:

① FOR SER. NO. 123 THRU 255, 257 THRU 281, 283 THRU 290, 295, 297, 300, 303, 304, 306 C4 WAS NOT USED

② FOR SER. NO. 123 THRU 159: C206, C208, C213 WERE .5uf C205 WAS 40 uf R238 REPLACED BY CR201
FOR SER. NO. 160 THRU 195 R238 NOT USED

④ FOR SER. NO. 123 THRU 195 R518 WAS 5.6K

⑤ FOR SER. NO. 123 THRU 197 C101 WAS 150 uf C101 WAS 20 uf

⑥ FOR SER. NO. 123 THRU 295 R 410 NOT USED

⑦ FOR SER. NO. 123 THRU 197 (APPROX) C406 REPLACED BY 2 EA. 22 pf CONNECTED IN SERIES

⑧ FOR SER. NO. 123 THRU 159 (APPROX) C408 WAS 180 TO 480 pf

⑨ FACTORY SELECTED. NOMINAL VALUE SHOWN.

VOLTAGE RANGE	NULL SIGNAL				
	LO	MED LO	MED HI	HI
.01	LO	LO	LO	LO	LO
.03	LO	LO	LO	LO	LO
.1	LO	LO	LO	LO	LO
.3	LO	LO	LO	LO	LO
1	LO	LO	LO	LO	LO
3	LO	LO	LO	LO	LO
10	LO	LO	LO	LO	LO
30	LO	LO	LO	LO	LO
100	LO	LO	LO	LO	LO
300	LO	LO	LO	LO	LO
1000	LO	LO	LO	LO	LO

NOTES:
REFERENCE DESIGNATIONS
BT 1, 2
C 1-102, 201-315, 401-407, 501-522
CR 101-104, 201, 501-507
J 1-3, 201-202
L 1
M 1
Q 101-104, 201-209, 501-508
R 1-119, 201-324, 401-457, 501-538, 601-616, 801-815, 901-905
S 1-301-305
V 601

▷ ALL FLAGNOTES WITH THE SAME NUMBER ARE CONNECTED
⏚ INDICATES -16.5 V RETURN
⏚Z INDICATES +18V RETURN

FUNCTIONAL SCHEMATIC
DIFFERENTIAL VOLTMETER
MODELS 873A and 873AB

873A	SER. NO.	123 & ON
873AB	SER. NO.	123 & ON

FLUKE JOHN FLUKE MFG. CO., INC.
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BA-A-873

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